INTERNATIONAL MARITIME ORGANIZATION

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SUB-COMMITTEE ON SAFETY OF NAVIGATION
48th session
Agenda item 19

NAV 48/19/Add.1
4 October 2002
Original: ENGLISH

REPORT TO THE MARITIME SAFETY COMMITTEE

Attached is annex 14 to the report of the Sub-Committee on Safety of Navigation on its forty-eighth session (NAV 48/19).

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ANNEX 14

PROPOSED AMENDMENTS TO THE DRAFT REVISED FISHING VESSEL SAFETY CODE AND THE VOLUNTARY GUIDELINES

CHAPTERS OF THE DRAFT REVISED FISHING VESSEL SAFETY CODE ~~TO BE REVIEWED BY THE NAV SUB-COMMITTEE~~

Preface

1 The Code of Safety for Fishermen and Fishing Vessels originated from a resolution adopted by the International Labour Organization (ILO) in 1962. Subsequent to that resolution, the Food and Agriculture Organization (FAO), ILO and the International Maritime Organization (IMO)~~*~~ entered into an agreement to co-operate, within their respective fields of experience, to elaborate the Code. The agreement acknowledged that the respective areas of competence are:

- FAO - fisheries in general;
- ILO - labour in the fishing industry; and
- IMO - safety of life, vessels and equipment at sea.

The Code was elaborated in two parts:

- part A to be addressed to skippers and crews, containing operational and occupational requirements; and
- part B to be addressed to shipbuilders and owners containing requirements for the construction and equipment for fishing vessels.

2 Part A of the Code was adopted by the first session of the Joint FAO/ILO/IMO Meeting of Consultants on Safety on Board Fishing Vessels which was held at ILO Headquarters in Geneva in September 1968.

3 Later amendments to part A were approved by the Maritime Safety Committee of IMO, at its 30th session in the Spring of 1973. At the same session, the Committee approved the final text of part B which was endorsed by the FAO Council at its 64th session (Autumn 1974) and also endorsed by the Governing Body of the ILO at its 195th session (February 1975).

4 In 1977, an International Conference on the Safety of Fishing Vessels adopted the Torremolinos International Convention on the Safety of Fishing Vessels, 1977 which, for a number of reasons did not enter into force. Consequently, a further International Conference was convened, also in Torremolinos, Spain, that adopted the Torremolinos Protocol of 1993 relating to the Torremolinos International Convention on the Safety of Fishing Vessels, 1977, hereinafter referred to as the Protocol.

~~* The former name of the Organization, the Inter-Governmental Maritime Consultative Organization (IMCO) was changed to the "International Maritime Organization (IMO)" by virtue of amendments to the Organization's Convention which entered into force on 22 May 1982.~~

Note: For easy reference, the relevant changes are shown as the proposed new text underlined and deleted text struck-out.

5 The Conference also adopted, *inter alia*, resolution 4 in which it is noted that that the Protocol does not contain specific requirements for certain safety equipment for fishing vessels of less than 45 m in length, such as life-saving appliances. Consequently, it urged all States, in view of the of the inherent risks involved in the operation of fishing vessels, to consider the requirements for safety equipment when deciding, in accordance with article 3(4) of the Protocol, which regulations they should apply, wholly or in part, to fishing vessels of 24 m in length and over but less than the applicable length criteria of the chapter in question.

6 It was also noted, that initiatives had been taken by certain States to develop uniform regional standards as called for in article 3(5) of the Protocol to ensure that the safety of fishing vessels covered by article 3(4) thereof is maintained at an acceptable level by determining which regulations, contained in the annex to the Protocol should apply, wholly or in part, to such vessels.

7 In its review of regional standards so developed, the Maritime Safety Committee (MSC) of IMO noted that they had been examined by SLF with a view to the desirability of developing a template for other countries or regions (see documents MSC 68/INF.10 and MSC 70/INF.24). It was also noted, that in the examination process, the provisions of these regional standards had provided valuable information in relation to the revision of part B of the Code.

8 The Maritime Safety Committee of IMO accepted that for certain sizes of vessels, the minimum standards contained in the Protocol should be applied and considered that it would be appropriate to refer to such provisions of the Protocol, where relevant, in the revised text of Part B of the Code. It was also accepted by the Committee, that any such references must stress the voluntary nature of the Code and substitute the mandatory terms "shall" and "will" with the word "should".

9 The Maritime Safety Committee of IMO acknowledged that there had been significant developments in relation to the management of fisheries that contained principles in support of the safety of fishermen and fishing vessels. It noted in particular the:[*]

.1 Agreement for the Interpretation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks of 1995; and

.2 Code of Conduct for Responsible Fisheries adopted by the Conference of FAO in 1995.

10 The Maritime Safety Committee of IMO recognized that the safety at sea aspects contained within these instruments could be relevant in relation to the revision of part B, in particular the:

.1 arrangements for the monitoring control and surveillance of fishing vessels including recommendations for the reporting of the position of a fishing vessel at sea;

[*] IMO has been informed by the UNGA, CSD and FAO of the existence of these instruments. More recently (1999/2000) FAO has provided more detailed information in relation to IUU fishing to the MSC and MEPC and the FSI Sub-Committee.

.2 marking of fishing vessels in accordance with uniform and internationally recognized systems such as the FAO Standard Specifications for the Marking and Identification of Fishing Vessels[†]; and

.3 the integration of fishing vessels into search and rescue systems.

11 In entrusting the revision of part B of the Code to the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF), the Maritime Safety Committee of IMO recommended that the recent developments in fishing vessel design and fishing operations should be taken into consideration. In this regard, IMO was requested to invite FAO and ILO to participate in the revision. Both Organizations responded positively to the subsequent invitation.

12 The Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF) established a correspondence group[*] to facilitate the revision of part B of the Code and following clearance by the relevant Sub-Committees of the IMO, the revised text was submitted to the Maritime Safety Committee of IMO at its xx session (year) at which it was approved.

13 The Maritime Safety Committee of IMO also considered the question of stationing in all principle fishing grounds of vessels which could provide hospital, rescue and emergency repair facilities, and noted that in the major regulatory areas, fisheries protection vessels were deployed. It was noted, however, that in many areas, fisheries protection had been sub-contracted to governmental and non-governmental agencies or entities and that the vessels involved were not always dedicated protection vessels.[‡] Thus the Committee considered that the information note on Support Vessels on Principle Fishing Grounds attached to part B (in 1975) is outdated and should be deleted.

14 Consequently, it was recommended that IMO in cooperation with FAO should investigate the utility of providing a similar information note in light of the developments in fisheries management that could contribute to the safety of fishermen and the safety of fishing vessels[§].

15 The Maritime Safety Committee recalled that it had been informed at its seventy-second session, March 2000, by ILO of the outcome of its Tripartite Meeting on safety and health in the fishing industry, Geneva, 13 to 17 December 1999 (MSC72/22/6). The Committee noted with appreciation that, following consultation with IMO, ILO considered that ILO should take a leading role in revising the Code of Safety for Fishermen and Fishing Vessels, Part A, Safety and Health and Practice.

16 Concerning the procedures for future amendments to both parts A and B of the Code, the Maritime Safety Committee of IMO considered that any amendments should be effected as expeditiously as possible. It was agreed that non-controversial amendments should be approved by correspondence but joint meetings of experts might be necessary for other amendments for which no ready agreement by correspondence can be reached.

[†] Refer to MSC/Circ.5782.

[*] A list of the Members of the Correspondence Group is given on pages xx - xxx.

[‡] This refers to the fact that normal commercial fishing vessels are often used on a rotational basis or under contract.

[§] Alternatively, the information note could describe systems for the integrated monitoring of fisheries and give details of where such systems are currently in place whether voluntary or mandatory.

17 Recognizing that the majority of items covered by the Code are within the scope of IMO and noting the different working procedures within the three Organizations and that the IMO Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF) holds regular meetings, it was agreed that:

.1 IMO should act as a focal point for coordinating proposed amendments to the Code and in particular the IMO Secretariat should undertake to receive any proposed amendments, to distribute them to the Organizations and to collate their respective comments;

.2 any future joint FAO/ILO/IMO meeting should be held, whenever possible, in conjunction with a meeting of the Sub-Committee; and

.3 any proposed amendments should always be subject to the final approval of the appropriate bodies of the three Organizations.

18 Part A as revised by the second Joint Meeting of Consultants is published by IMO as a separate booklet (Sales Number 75.08.E).

CHAPTER I
GENERAL PROVISIONS

1.1 Purpose and Scope

1.1.1 The purpose of this part of the Code is to provide information on design, construction and equipment of fishing vessels with a view to promoting the safety of fishing vessels and safety and health of the crew. The Code is not a substitute for national laws and regulations nor is it a substitute for the provisions of international instruments in relation to safety of fishing vessels and crew although it may serve as a guide to those concerned with framing such national laws and regulations.

1.1.2 The Code is voluntary. It is wider in scope than the Torremolinos Protocol and only the minimum requirements to ensure the safety of fishing vessels and safety and health of the crew are given in this part of the Code for fishing vessels of 24m in length and above. Each competent authority should take every possible measure to promote the safety of the vessels concerned.

1.1.3 Certain sections of this part of the Code make reference to the minimum standards set out in the provisions of the Torremolinos International Convention for the Safety of Fishing Vessels, 1977, as modified by the Torremolinos Protocol of 1993 relating thereto. For the purpose of this part of the Code, these are considered to be the minimum standards acceptable in relation to the classes of vessels, as prescribed in the Protocol, to which they should be applied.

1.1.4 Regional uniform standards or guidelines that have been submitted to IMO as provided for under Article 3, Paragraphs (4) and (5) of the Protocol for fishing vessels registered and operating in such regions, prevail over Chapters IV, V, VII and IX of this part of the Code. For all other fishing vessels of 24 m in length and over but less than 45 m in length, that are registered in such regions but operate, or are intended for operation outside the region, the whole of this part of the Code would serve as a guide.

1.1.5 Unless otherwise stated, the provisions of this part of the Code are intended to apply to new decked fishing vessels of 24 m in length and above and in the following categories:

Category 1 - Vessels intended for fishing operations in unlimited sea areas;

Category 2 - Vessels intended for fishing operations in sea areas up to 200 nautical miles from a place of shelter;

Category 3 - Vessels intended for fishing operations in sea areas up to 50 nautical miles from a place of shelter.

However, even where not otherwise stated, the competent authority should also apply these provisions, as far as reasonable and practicable, to existing decked fishing vessels.

1.1.6 The provisions of this part of the Code do not apply to fishing vessels for sport or recreation or to processing vessels.

1.1.7 Where operating experience has clearly shown that departure from the provisions of this part of the Code is justified, or in applying this part of the Code to any other equivalent area of operation for any vessel covered by this Part of the Code, the competent authority may permit adequate alterations or substitutions thereof.

1.2 Definitions

1.2.1 For the purpose of this part of the Code, unless expressly provided otherwise, the following definitions apply:

~~(i)~~.1 *Fishing vessel* - in the following referred to as *vessel* - is a vessel used commercially for catching fish, whales, seals, walrus, or other living resources of the sea.

~~(ii)~~.2 *Processing vessel* is a vessel used exclusively for processing fish and other living resources of the sea.

~~(iii)~~.3 *Crew* means the skipper and all persons employed or engaged in any capacity on board a vessel on the business of that vessel.

~~(iv)~~.4 *Competent authority* is the government of the State whose flag the vessel is entitled to fly.

~~(v)~~.5 *New vessel* is a vessel the keel of which is laid, or which is at a similar stage of construction, on or after the date of adoption of the present revision to this Part of the Code.

~~(vi)~~.6 *Existing vessel* is a vessel which is not a new vessel.

~~(vii)~~.7 *Convention* means the International Convention for the Safety of Life at Sea, 1974.

~~(viii)~~.8 *Protocol* means the Torremolinos International Convention for the Safety of Fishing Vessels, 1977, as modified by the Torremolinos Protocol of 1993 relating thereto.

~~(ix)~~.9 *Place of shelter* is any naturally or artificially protected area easily accessible to the vessel and which can be used for sheltering the vessel ~~in~~ from circumstances which are unfavourable to its safety.

~~(x)~~.10 *Length* (L)* is to be taken as 96% on the waterline at 85% of the least depth measured from the keel line, or as the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In vessels designed with rake of keel the waterline on which this length is measured is to be parallel to the designed waterline.

~~(xi)~~.11 The *forward and after perpendiculars* are to be taken at the forward and after ends of the length (L). The forward perpendicular is to be coincident with the foreside of the stem on the waterline on which the length is measured.

* Amendments adopted in 1983.

~~(xii)~~.12 *Breadth* (B)* is the maximum breadth of the vessel, measured amidships to the moulded line of the frame in a vessel with a metal shell and to the outer surface of the hull in a vessel with a shell of any other material.

~~(xiii)~~.13 (a) *The moulded depth* is the vertical distance measured from the keel line to the top of the working deck beam at side.

(b) In vessels having rounded gunwales, the moulded depth is to be measured to the point of intersection of the moulded lines of deck and side shell plating, the lines extending as though the gunwale were of angular design.

(c) Where the working deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth is measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

~~(xiv)~~.14 The *depth (D)* is the moulded depth amidships.

~~(xv)~~.15 *Least depth** is the depth measured from the keel line to the top of the working deck beam at side at the point where a parallel to the keel line is tangent to the deck line. Where the working deck is stepped and the raised part of the deck extends over the point at which the least depth is to be determined, the least depth should be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

~~(xvi)~~.16 *Deepest operating waterline* is the waterline related to the maximum permissible operating draft.

~~(xvii)~~.17 *Freeboard* (f_{min}) is the actual minimum freeboard and is the distance from the underside of the working deck at the side to a water-line, measured perpendicularly to the water-line, plus the minimum thickness of decking. When the working deck is stepped, the lowest line of the deck and the continuation of that line parallel to the upper part of the deck is to be taken as the working deck.

~~(xviii)~~.18 *Amidships* is the mid-length of L.

~~(xix)~~.19 *Midship section* is that section of the hull defined by the intersection of the moulded surface of the hull with a vertical plane perpendicular to the water and centreline planes passing through amidships.

~~(xx)~~.20 *Keel line** is the line parallel to the slope of keel passing amidships through:

(a) the top of the keel or line of intersection of the inside of shell plating with the keel where a bar keel extends above that line of a vessel with a metal shell; or

* Amendments adopted in 1983.

(b) the rabbet lower line of the keel of a vessel with a shell of wood or a composite material;

(c) the intersection of a fair extension of the outside of the shell contour at the bottom with the centreline of a vessel with a shell of material other than wood and metal.

~~(xxi)~~.21 *Baseline* is the horizontal line intersecting at amidships the keel line.

~~(xxii)~~.22 *Working deck* is generally the lowest complete deck above the deepest operating waterline from which fishing is undertaken. In vessels fitted with two or more complete decks, the competent authority may accept a lower deck as a working deck provided that that deck is situated above the deepest operating waterline.

~~(xxiii)~~.23 *Superstructure* is the decked structure on the working deck extending from side to side of the vessel or with the side plating not being inboard of the shell plating more than 0.04 B.

~~(xxiv)~~.24 *Enclosed superstructure* is a superstructure with:

~~(a)~~.1 enclosing bulkheads of efficient construction;

~~(b)~~.2 access openings, if any, in those bulkheads fitted with permanently attached weathertight doors of a strength equivalent to the unpierced structure which can be operated from each side; and

~~(c)~~.3 other openings in sides or ends of the superstructure fitted with efficient weathertight means of closing.

A raised quarter-deck is regarded as a superstructure.

A bridge or poop should not be regarded as enclosed unless access is provided for the crew to reach machinery and other working spaces inside those superstructures by alternative means which are available at all times when bulkhead openings are closed.

~~(xxv)~~.25 *Superstructure deck* is that complete or partial deck or the top of a superstructure, deckhouse or other erections situated at a height of not less than 1.8 m above the working deck. Where this height is less that 1.8 m, the top of such deckhouses or other erections should be treated in the same way as the working deck.

~~(xxvi)~~.26 *Height of a superstructure or other erection is* the least vertical distance measured at side from the top of the deck beams of a superstructure or an erection to the top of the working deck beams.

~~(xxvii)~~.27 *Weather deck is* the uppermost deck exposed to weather and sea. Where the deck is not continuous the uppermost deck at the point in question should be taken as the weather deck**.**

~~(xxviii)~~.28 *Weathertight* means that in any sea conditions water will not penetrate into the vessel.

~~(xxix)~~.29 *Watertight* means capable of preventing the passage of water through the structure in any direction under a head of water for which the surrounding structure is designed.

~~(xxx)~~.30 *Collision bulkhead* is a watertight bulkhead up to the working deck in the forepart of the vessel which meets the following conditions:

~~(a)~~.1 The bulkhead is to be located at a distance from the forward perpendicular:

~~(i)~~ .1 not less than 0.05L and not more than 0.08L for vessels of 45m and over:

~~(ii)~~.2 not less than 0.05L and not more than 0.05L plus 1.35m for vessels less than 45m in length except as may be allowed by the competent authority:

~~(iii)~~.3 in no case less than 2.0m.

~~(b)~~.2 Where any part of the underwater body extends forward of the forward perpendicular, e.g. a bulbous bow, the distance stipulated in subparagraph ~~(a)~~.1 is to be measured from a point at mid-length of the extension forward of the forward perpendicular or from a point 0.015L forward of the forward perpendicular, whichever is less.

~~(c)~~.3 The bulkhead may have steps or recesses provided they are within the limits prescribed in subparagraph ~~(a)~~.1.

~~(xxxi)~~.31 *Bow height*, defined as the vertical distance at the forward perpendicular between the waterline corresponding to the maximum permissible operating draught and the designed trim and the top of the exposed deck at side.

~~(xxxii)~~.32 *Organization* means the International Maritime Organization*.

~~(xxxiii)~~.33 *Approved* means approved by the competent authority.

1.2.2 In this Part of the Code measurements are given in the metric system using the following abbreviations:

m	-	metre	
cm	-	centimetre	
mm	-	millimetre	
t	-	tonne (1,000 kg)	
kg	-	kilogramme	
mt	-	metre - tonne	
° C	-	degree centigrade	
sec	-	second	
N	-	Newton	
~~K~~kW	-	~~K~~kilowatt	kN∗m/sec

* Drawn from Article 2 of the 1993 Torremolinos Protocol

1.3 Surveys

1.3.1 The hull, machinery, equipment and radio installations should be surveyed on completion and thereafter in such manner and at such intervals as the competent authority or a classification society recognized by the competent authority may consider necessary in order to ensure that their condition is in all respects satisfactory. The surveys should be such as to ensure that the arrangements, material, and scantlings of the structure, boilers and other pressure vessels and their appurtenances, main and auxiliary machinery, electrical installations as well as crew accommodation and other equipment are in all respects satisfactory for the service for which the vessel is intended.

1.3.2 After any survey has been completed, no change should be made in the structural arrangements, machinery, equipment, etc., covered by the survey, without the sanction of the competent authority.

1.3.3 A fishing vessel should carry on board documentation relating to the safety of the vessel issued by the competent authority.

1.3.4 Documentation relating to the safety of the vessel should cease to be valid upon transfer of the vessel to the flag of another State. New safety documentation should only be issued when the competent authority is fully satisfied that the vessel is in compliance with the requirements of the relevant provisions.

1.4 Equivalents

Where the present provisions require that a particular fitting, material, appliance or apparatus, or type thereof, shall be fitted or carried in a vessel, or that any particular provision shall be made, the competent authority may allow any other fitting, material, appliance or apparatus, or type thereof, to be fitted or carried, or any other provision to be made in that vessel, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance or apparatus, or type thereof, or provision, is at least as effective as that required by the present provisions.[*]

[*] Drawn from the text of regulation I/4(1) of the Torremolinos Protocol

CHAPTER X
SHIPBORNE NAVIGATIONAL EQUIPMENT AND ARRANGEMENTS

10.1 Shipborne navigational equipment*.[317]

10.1.1 Vessels should be fitted with:

~~(i)~~.1 a standard magnetic compass, except as provided in 10.1.5;

~~(ii) a steering magnetic compass, unless heading information provided by the standard compass required under (i) is made available and is clearly readable by the helmsman at the main steering position;~~

~~(iii) adequate means of communication between the standard compass position and the normal navigation control position to the satisfaction of the competent authority; and~~

~~(iv)~~.2 means for taking bearings as nearly as practicable over an arc of the horizon of 360°.[318]

10.1.2 ~~Each~~ The magnetic compass referred to in 10.1.1 should be properly adjusted and its table or curve of residual deviations should be available at all times.[319]

10.1.3 A spare magnetic compass, interchangeable with the standard compass, should be carried by vessels of 35m in length and over, unless ~~the steering compass mentioned in 10.1.1 subparagraph (ii) or~~ a gyro-compass is fitted.[320]

10.1.4 It should be possible to read the compasses by day and by night. ~~It should also be possible to take bearings by day or by night using the standard or steering compass or a pelorus. Magnetic compasses should be provided with means for adjustment; securing devices for compasses and compensators should be made of non-magnetic materials. Compasses should be sited as near the fore-and-aft line of the vessel as practicable, with the lubber line, as accurately as possible, parallel with the fore-and-aft line. Compasses should comply with the requirements of the competent authority.~~[321]

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* See the Recommendation on the Carriage of Electronic Position-Fixing Equipment adopted by the Organization by resolution A.156(ES.IV) and the World-Wide Radionavigation System adopted by the Organization by resolution ~~A.666(16).~~A.815(19).

[317] Please refer to paragraph 10.1.1 of the existing Code.
[318] Please refer to regulation X/3(1)(a) of the Protocol.
[319] Please refer to regulation X/3(1)(b) of the Protocol.
[320] Please refer to regulation X/3(1)(c) of the Protocol.
[321] ~~Please refer to paragraph 10.1.2 of the existing Code and to paragraph 9.2.2 of the existing Guidelines.~~

10.1.5 The competent authority, if it considers it unreasonable or unnecessary to require a standard magnetic compass, may exempt individual vessels or classes of vessels from these requirements if the nature of the voyage, the vessel's proximity to land or the type of vessel does not warrant a standard compass, provided that a suitable steering compass is in all cases carried.[322] [321] [323][322]

10.1.6 Vessels intended for operation at high latitudes and vessels of 45 m in length and over should be fitted with a gyro-compass complying with the following requirements: [of regulation X/3(3) of the 1993 Torremolinos Protocol.][324]

.1 the master gyro-compass or a gyro-repeater shall be clearly readable by the helmsman at the main steering position;

.2 on vessels of 75 m in length and over a gyro-repeater or gyro-repeaters shall be provided and shall be suitably placed for taking bearings as nearly as practicable over an arc of the horizon of 360°.[323]

10.1.7 Vessels with emergency steering positions should at least be provided with a telephone or other means of communication for relaying heading information to such positions. In addition, vessels of 45 m in length and over equipped with gyro-compass should be provided with arrangements for supplying visual compass readings to the emergency steering position.[325][324]

10.1.8 In vessels equipped with an auto-pilot system actuated by a magnetic sensor, which does not indicate the vessel's heading, suitable means should be provided to show this information. [compass, there should be installed another magnetic compass so positioned that the course of both compasses might be read from the main steering position.]

[In vessels equipped with a gyro-compass, the course of the standard magnetic compass should be readable from the main steering position. To comply with the requirement that magnetic compasses should be properly compensated, all magnetic compasses should be placed in a binnacle of such size that vertical and horizontal magnetic fields can be compensated. Auto-pilot systems should comply with the requirements of the competent authority.][326]

10.1.9 Vessels [of 24 m in length and over] should be fitted with a radar installation. The radar installation should be capable of operating in the 9 GHz frequency band. Vessels of 24 m in length and over but less than 45 m may be exempted from compliance with the requirements of 10.1.[17]16 at the discretion of the competent authority, provided that the equipment is fully compatible with the radar transponder for search and rescue.[327][325]

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[322] [321] Please refer to regulation X/3(1)(d) of the Protocol.

[323] [322] [Proposal by Norway: It should be further considered to delete this sub-paragraph, as we believe all vessels should be provided with a magnetic compass. A magnetic compass is of particular importance in fog, which could just as well occur near the coast as on the open sea. Alternatively, a similar provision as 10.1 in the Guideline and X/2 in the Protocol should be considered, as this will give the competent authority a general discretion to exempt vessels from navigational equipment.]

[324] [323] Please refer to paragraph 10.1.1 of the existing Code and to regulation X/3(3) and X/3(4) of the Protocol.

[325] [324] Please refer to regulation X/3(5) of the Protocol.

[326] [Please refer to paragraph 10.1.3 of the existing Code.]

[327] [325] Please refer to paragraph 10.1.5 of the existing Code and to regulation X/3(6) of the Protocol.

10.1.~~11~~10 Facilities for plotting radar readings should be provided on the navigating bridge of vessels required by 10.1.9 to be fitted with a radar installation. ~~In v~~Vessels of 75 m in length and over ~~the plotting facilities should be at least as effective as a reflection plotter~~should be fitted with an electronic plotting aid, or other means, to plot electronically the range and bearing of targets to determine collision risk.~~328~~326

10.1.~~12~~11 Vessels of 45 m in length and over should be fitted with an echo-sounding device.~~329~~327

10.1.~~13~~ 12 Vessels of less than 45 m in length should be provided with suitable means to the satisfaction of the competent authority for determining the depth of water under the vessel.~~330~~ 328 Where fish-finding devices are fitted they could be used for that purpose.

10.1. ~~14~~13 Vessels of 45 m in length and over should be fitted with a device to indicate speed and distance.~~331~~329

10.1. ~~15~~14 Vessels of 45 m in length and over should be fitted with indicators showing the rudder angle, the rate of revolution of each propeller and in addition, if fitted with variable pitch propellers or lateral thrust propellers, the pitch and operational mode of such propellers. All these indicators should be readable from the conning position.~~332~~330

10.1. ~~16~~15 Vessels ~~of 75 m in length and over~~ should be fitted with ~~a radio direction finding apparatus~~a receiver for a global navigation satellite system or a terrestrial radionavigation system, or other means, suitable for use at all times throughout the intended voyage to establish and update the ship's position by automatic means. The competent authority may exempt a vessel from this requirement if it considers it unreasonable or unnecessary for such apparatus to be carried or if the vessel is provided with other radionavigation equipment suitable for use throughout its intended voyages.~~333~~331

10.1. ~~17~~16 All equipment fitted in compliance with this section should be of a type approved ~~by~~ at the discretion of the competent authority. Equipment installed on board vessels should conform to appropriate performance standards. Such standards wherever applicable, should be not inferior to those adopted by the Organization.~~334~~332 *

~~328~~ 326 Please refer to regulation ~~X/3(8) of the Protocol~~V/19.2.3.3 of the Convention.
~~329~~ 327 Please refer to regulation X/3(9) of the Protocol.
~~330~~ 328 Please refer to regulation X/3(10) of the Protocol.
~~331~~ 329 Please refer to regulation X/3(11) of the Protocol.
~~332~~ 330 Please refer to regulation X/3(12) of the Protocol.
~~333~~ 331 Please refer to regulation X/3(14) of the Protocol.
~~334~~ 332 Please refer to regulation X/3(16) of the Protocol.

* See the following resolutions adopted by the Assembly of the Organization:

~~.1 Resolution A.694(17), "~~Recommendation on General Requirements for Shipborne Radio Equipment Forming Part of the GMDSS and for Electronic Navigational Aids (resolution A 694(17))~~"~~;

~~.2 Resolution. A.382(X), "~~Recommendation on Performance Standard for Magnetic Compasses (resolution. A.382(X))~~"~~;

~~.3 Resolution A.424(XI), "~~Recommendation on Performance Standards for Gyro-Compasses (resolution A.424(XI))~~"~~;

~~.4 Resolutions A.477(XII) and A.278(VIII), "Recommendation on Performance Standards for Radar Equipment";~~ Recommendation on Performance Standards for radar equipment (resolution MSC.64(67), annex 4);

~~.5 Resolution A.823(19), "~~Performance standards for automatic radar plotting aids (ARPAs)(resolution A.823(19))~~"~~;

~~.6~~ Recommendation on Performance Standards for echo-sounding equipment (resolution A.224(VII), as amended by resolution MSC.74(69), annex 4);~~Resolution A.224(VII), "Recommendation on Performance Standards for Echo Sounding Equipment";~~

10.2 Nautical ~~instruments~~ charts and nautical publications

~~Suitable nautical instruments, adequate and up-to-date charts, sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage, to the satisfaction of the competent authority, should be carried on board.~~[335]

10.2.1 Vessels should have:

.1 nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage; an electronic chart display and information system (ECDIS) [†] may be accepted as meeting the chart carriage requirements of this subparagraph;

.2 back-up arrangements to meet the functional requirements of subparagraph .1, if this function is partly or fully fulfilled by electronic means;[*]

~~.7~~ Recommendation on Performance Standards for devices to indicate speed and distance (resolution A.824(19)), as amended by resolution MSC.96(72);~~Resolution A.824(19), "Performance standards for devices to indicate speed and distance";~~

~~.8 Resolution A.526(13), "~~Performance Standards for Rate-of-Turn Indicators (resolution A.526(13))~~";~~;

~~.9 Resolution A.575(14), "~~Recommendation on Unification Performance Standards for Navigational Equipment (resolution A.575(14))~~";~~;

~~.10 Resolution A. 665(16), "Performance Standards for Radio Direction-Finding Systems";~~

~~.11 Resolution A.479(XII), "Recommendation on Performance Standard for Shipborne Receivers for Use with Differential OMEGA";~~

~~.12 Resolution A.343(IX), "~~Recommendation on Methods of Measuring Noise Levels at Listening Posts (resolution A.343(IX))~~".~~

~~Regarding unification of ARPA signals, see MSC/Circ.563 and IEC Publication 872.~~

Recommendation on Performance Standards for shipborne global positioning system receiver equipment (resolution A.819(19)) as amended by resolution MSC.112(73);

Recommendation on Performance Standards for shipborne GLONASS receiver equipment (resolution MSC.53(66)) as amended by resolution MSC.113(73);

Recommendation on Performance Standards for combined GPS/GLONASS receiver equipment (resolution MSC.74(69), annex 1) as amended by resolution MSC.115(73);

Recommendation on Performance Standards for heading control systems (resolution MSC.64(67), annex 3);

Recommendation on accuracy standards for navigation (resolution A.529(13));

Recommendation on Performance Standards for shipborne Loran-C and Chayka receivers (resolution A.818(19));

Recommendation on Performance Standards for shipborne DGPS and DGLONASS maritime radio beacon receiver equipment (resolution MSC.64(67), annex 2) as amended by resolution MSC.114(73);

Recommendation on Performance Standards for track control systems (resolution MSC.74(69), annex 2);

Recommendation on Performance Standards for a universal shipborne automatic identification system (AIS) (resolution MSC.74(69), annex 3);

Recommendation on Performance Standards for radar reflectors (resolution A.384(X));

Recommendation on Performance Standards for sound reception systems (resolution MSC.86(70), annex 1);

Recommendation on Performance Standards for voyage data recorders (VDRs) (resolution A.861(20));

[†] Recommendation on Performance Standards for Electronic Chart Display and Information Systems (ECDIS) (resolution A.817(19)), as amended by resolutions MSC.64(67), annex 5 and MSC.86(70), annex 4, as appropriate;

~~[335] Please refer to regulation X/4 of the Protocol.~~

[*] An appropriate folio of paper nautical charts may be used as a back-up arrangement for ECDIS. Other back-up arrangements for ECDIS are acceptable (see appendix 6 to resolution A.817(19), as amended).

10.2.2 Nautical charts and nautical publications, such as sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage, shall be adequate and up to date.

10.3 Signalling equipment

10.3.1 Attention is drawn to the need to provide the equipment to comply in every respect with the requirements of the International Regulations for Preventing Collisions at Sea, 1972, as amended.[336]333

10.3.2 Lights, shapes and flags should be provided to indicate that the vessel is engaged in any specific operation for which such signals are used.[337]334

10.3.3 A daylight signalling lamp* should be provided, the operation of which is not solely dependent upon the main source of electrical power. The power supply should in any case include a portable battery.[338]335

10.3.4 Vessels of category 1 and vessels of 45 m in length and over should be provided with a full complement of flags and pendants to enable communications to be sent using the International Code of Signals.[339]336

10.3.5 All vessels which are required to carry radio installations should carry the International Code of Signals. This publication should also be carried by any other vessel which, in the opinion of the competent authority, has a need to use it.[340]337

10.4 Navigating bridge visibility[341]338

10.4.1 ~~New v~~Vessels of not less than ~~24~~45 m in length ~~and over~~ should meet the following requirements:

~~(a)~~.1 The view of the sea surface from the conning position should not be obscured by more than two vessel lengths, or 500 m, whichever is less, forward of the bow to 10 degrees on either side irrespective of the vessel's draught and trim;

~~(b)~~.2 No blind sector caused by fishing gear or other obstructions outside of the wheelhouse forward of the beam which obstructs the view of the sea surface as seen from the conning position, should exceed 10º. The total arc of blind sectors should not exceed 20º. The clear sectors between blind sectors should be at least 5º. However, in the view described in subparagraph ~~(a)~~.1 each individual blind sector should not exceed 5º;

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[336]333 Please refer to paragraph 10.3.1 of the existing Code and to paragraph 9.4.1 of the existing Guidelines.

[337]334 Please refer to paragraph 10.3.2 of the existing Code.

[338]335 Please refer to regulation X/5(1) of the Protocol.

* Recommendation on Performance Standards for daylight signalling lamps (resolution MSC.95(72)).

[339]336 Please refer to paragraph 10.3.4 of the existing Code and to regulation X/5(2) of the Protocol.

[340]337 Please refer to regulation X/5(3) of the Protocol.

[341]338 Please refer to regulation X/6 of the Protocol.

~~(c)~~.3 The height of the lower edge of the navigation bridge front windows above the bridge deck should be kept as low as possible. In no case should the lower edge present an obstruction to the forward view as described in this regulation;

~~(d)~~.4 The upper edge of the navigation bridge front windows should allow a forward view of the horizon for a person with a height of eye of 1,800 mm above the bridge deck at the conning position when the vessel is pitching in heavy seas. However, the competent authority, being satisfied that a 1,800 mm height of eye is unreasonable and impractical, may reduce the height of eye but not to less than 1,600 mm;

~~(e)~~.5 The horizontal field of vision from the conning position should extend over an arc of not less than 225º, that is from right ahead to not less than 22.5º abaft the beam on either side of the vessel;

~~(f)~~.6 From each bridge wing the horizontal field of vision should extend over an arc of at least 225º, that is from at least 45º on the opposite bow through right ahead and then from right ahead to right astern through 180º on the same side of the vessel;

~~(g)~~.7 From the main steering position the horizontal field of vision should extend over an arc from right ahead to at least 60º on each side of the vessel;

~~(h)~~.8 The vessel's side should be visible from the bridge wing; and

~~(i)~~.9 Windows should meet the following requirements:

~~(i)~~.1 Framing between navigation bridge windows should be kept to a minimum and not be installed immediately forward of any workstation;

~~(ii)~~.2 To help avoid reflections, the bridge front windows should be inclined from the vertical plane top out, at an angle of not less than 10º and not more than 25º;

~~(iii)~~.3 Polarized and tinted windows should not be fitted; and

~~(iv)~~.4 A clear view through at least two of the navigating bridge front windows and depending on the bridge configuration, an additional number of clear view windows should be provided at all times regardless of weather conditions.

10.4.2 Existing vessels should, where practicable, meet the requirements of 10.4.1~~(a)~~.1 and ~~(b)~~.2. However, structural alterations or additional equipment need not be required.

10.4.3 On vessels of less than 45 m in length or of unconventional design which, in the opinion of the competent authority cannot comply with this regulation, arrangements should be provided to achieve a level of visibility that is as near as practicable to that prescribed in this regulation.

10.5 Pilot transfer arrangements

~~Where pilots are embarking or disembarking, pilot transfer arrangements should be provided complying with SOLAS regulation V/17.[342]~~

10.5.1 **Application**

10.5.1.1 Ships engaged on voyages in the course of which pilots are likely to be employed should be provided with pilot transfer arrangements.

10.5.1.2 Equipment and arrangements for pilot transfer which are installed on or after 1 January 1994 should comply with the requirements of this regulation, and due regard should be paid to the standards adopted by the Organization*.

10.5.1.3 Equipments and arrangements for pilot transfer which are provided on ships before 1 January 1994 should at least comply with the requirements of regulation V/17 of the International Convention for the Safety of Life at Sea, 1974 in force prior to that date, and due regard should be paid to the standards adopted by the Organization prior to that date.

10.5.1.4 Equipment and arrangements which are replaced after 1 January 1994 should, in so far as is reasonable and practicable, comply with the requirements of this regulation.

10.5.2 **General**

10.5.2.1 All arrangements used for pilot transfer should efficiently fulfill their purpose of enabling pilots to embark and disembark safely. The appliances should be kept clean, properly maintained and stowed and should be regularly inspected to ensure that they are safe to use. They should be used solely for the embarkation and disembarkation of personnel.

10.5.2.2 The rigging of the pilot transfer arrangements and the embarkation of a pilot should be supervised by a responsible officer having means of communication with the navigation bridge who should also arrange for the escort of the pilot by a safe route to and from the navigation bridge. Personnel engaged in rigging and operating any mechanical equipment should be instructed in the safe procedures to be adopted and the equipment should be tested prior to use.

10.5.3 **Transfer arrangements**

10.5.3.1 Arrangements should be provided to enable the pilot to embark and disembark safely on either side of the ship.

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[342] ~~Please refer to paragraph 10.4 of the existing Code.~~

* Refer to the Recommendation on pilot transfer arrangements, adopted by the Organization by resolution A.889(21), MSC/Circ.568/Rev.1: Required Boarding Arrangement for Pilots.

10.5.3.2 In all ships where the distance from sea level to the point of access to, or egress from, the ship exceeds 9 m, and when it is intended to embark and disembark pilots by means of the accommodation ladder, or by means of mechanical pilot hoists or other equally safe and convenient means in conjunction with a pilot ladder, the ship should carry such equipment on each side, unless the equipment is capable of being transferred for use on either side.

10.5.3.3 Safe and convenient access to, and egress from, the ship should be provided by either:

.1 a pilot ladder requiring a climb of not less than 1.5 m and not more than 9 m above the surface of the water so positioned and secured that:

.1.1 it is clear of any possible discharges from the ship;

.1.2 it is within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length of the ship;

.1.3 each step rests firmly against the ship's side; where constructional features, such as rubbing bands, would prevent the implementation of this provision, special arrangements should, to the satisfaction of the Administration, be made to ensure that persons are able to embark and disembark safely;

.1.4 the single length of pilot ladder is capable of reaching the water from the point of access to, or egress from, the ship and due allowance is made for all conditions of loading and trim of the ship, and for an adverse list of 15°; the securing strong point, shackles and securing ropes should be at least as strong as the side ropes;

.2 an accommodation ladder in conjunction with the pilot ladder, or other equally safe and convenient means, whenever the distance from the surface of the water to the point of access to the ship is more than 9 m. The accommodation ladder should be sited leading aft. When in use, the lower end of the accommodation ladder should rest firmly against the ship's side within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length and clear of all discharges; or

.3 a mechanical pilot hoist so located that it is within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length of the ship and clear of all discharges.

10.5.4 **Access to the ship's deck**

Means should be provided to ensure safe, convenient and unobstructed passage for any person embarking on, or disembarking from, the ship between the head of the pilot ladder, or of any accommodation ladder or other appliance, and the ship's deck. Where such passage is by means of:

.1 a gateway in the rails or bulwark, adequate handholds should be provided;

.2 a bulwark ladder, two handhold stanchions rigidly secures to the ship's structure at or near their bases and at higher points should be fitted. The bulwark ladder should be securely attached to the ship to prevent overturning.

10.5.5 **Shipside doors**

Shipside doors used for pilot transfer should not open outwards.

10.5.6 **Mechanical pilot hoists**

10.5.6.1 The mechanical pilot hoist and its ancillary equipment should be of a type approved by the Administration. The pilot hoist should be designed to operate as a moving ladder to lift and lower one person on the side of the ship, or as a platform to lift and lower one or more persons on the side of the ship. It should be of such design and construction as to ensure that the pilot can be embarked and disembarked in a safe manner, including a safe access from the hoist to the deck and vice versa. Such access should be gained directly by a platform securely guarded by handrails.

10.5.6.2 Efficient hand gear should be provided to lower or recover the person or persons carried, and kept ready for use in the event of power failure.

10.5.6.3 The hoist should be securely attached to the structure of the ship. Attachment should not be solely by means of the ship's side rails. Proper and strong attachment points should be provided for hoists of the portable type on each side of the ship.

10.5.6.4 If belting is fitted in the way of the hoist position, such belting should be cut back sufficiently to allow the hoist to operate against the ship's side.

10.5.6.5 A pilot ladder should be rigged adjacent to the hoist and available for immediate use so that access to it is available from the hoist at any point of its travel. The pilot ladder should be capable of reaching the sea level from its own point of access to the ship.

10.5.6.6 The position on the ship's side where the hoist will be lowered should be indicated.

10.5.6.7 An adequate protected stowage position should be provided for the portable hoist. In very cold weather, to avoid the danger of ice formation, the portable hoist should not be rigged until its use is imminent.

10.5.7 **Associated equipment**

10.5.7.1 The following associated equipment should be kept at hand ready for immediate use when persons are being transferred;

.1 two man-ropes of not less than 28 mm in diameter properly secured to the ship if required by the pilot;

.2 a lifebuoy equipped with a self-igniting light;

.3 a heaving line.

10.5.7.2 When required by paragraph 4, stanchions and bulwark ladders should be provided.

10.5.8 **Lighting**

Adequate lighting should be provided to illuminate the transfer arrangements overside, the position on deck where a person embarks or disembarks and the controls of the mechanical pilot hoist.

10.6 Documents

Vessels should be supplied with appropriate logs, certificates and other documents in accordance with the provisions of international and national regulations.[~~343~~339]

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[~~343~~339] Please refer to paragraph 10.5 of the existing Code.

~~ANNEX 2~~

PREAMBLE AND CHAPTERS OF THE VOLUNTARY GUIDELINES
~~TO BE REVIEWED BY THE NAV SUB-COMMITTEE~~

PREAMBLE

1 A meeting of consultants on safety on board fishing vessels, jointly convened in 1974 by the Food and Agriculture Organization of the United Nations (FAO), the International Labour Organization (ILO) and ~~the Inter-Governmental Maritime Consultative Organization (IMCO),~~ the International Maritime Organization (IMO), for the purpose of finalizing the text of Part B of the Code of Safety for Fishermen and Fishing Vessels, which applies to vessels of 24 metres in length and over, recommended that the three Organizations should continue to co-operate with a view to establishing voluntary guidelines for the design, construction and equipment of vessels of less than 24 metres in length.

2 Subsequently the Maritime Safety Committee of ~~IMCO~~ IMO took note of the aforementioned recommendation and requested its Sub-Committee on Safety of Fishing Vessels to develop such guidelines in co-operation with FAO and ILO.

3 The International Conference on Safety of Fishing Vessels, 1977, recognizing that the 1977 Torremolinos Convention applies only to fishing vessels of 24 metres in length and over and being conscious that the vast majority of fishing vessels throughout the world are of less than 24 metres in length, adopted a resolution recommending that ~~IMCO~~ IMO continue to develop safety standards for design, construction and equipment of such fishing vessels with a view to promoting the safety of these vessels and their crews.

4 The Preliminary draft of the Guidelines was prepared by FAO and comments thereon were made by the International Labour Office in respect of provisions concerning fishermen's conditions on board. The text was finalized at the twenty-first and twenty-second sessions of the ~~IMCO~~ IMO Sub-Committee on Safety of Fishing Vessels. The Guidelines were approved by the Maritime Safety Committee at its forty-first session in October 1979 and by the FAO in November 1979 for circulation to governments. The ILO Governing Body was informed at its 211th session in November 1979 of the intention to publish this document.

5 The purpose of the "Guidelines" is to provide a generally applicable code of safe practice for design, construction and equipment of smaller fishing vessels. Discretion should be exercised in using provisions of the "Guidelines" for the purpose of framing national safety requirements when local weather and sea conditions and special operational requirements should be given particular consideration.

6 It has to be pointed out that some parts of the Guidelines require further development. This mainly concerns stability criteria, which are considered at present as being only tentative. Bearing in mind that development of appropriate stability criteria for any type of fishing vessel is a very complex problem, which has not been entirely solved even for larger vessels, the International Conference on Safety of Fishing Vessels, 1977, adopted a resolution recommending that ~~IMCO~~ IMO continue studies with the aim of formulating detailed stability standards for fishing vessels.

7 Concerning the procedure for future amendments to the "Guidelines", the Maritime Safety Committee of ~~IMCO~~ IMO considered that any amendments should be effected as expeditiously as possible. It was suggested that non-controversial amendments could be agreed by correspondence between the three Organizations but approval by the Maritime Safety Committee of ~~IMCO~~IMO, the ILO Governing Body and the FAO might be necessary for amendments for which no ready agreement by correspondence may be reached.

ANNEX

DRAFT TEXT OF THE REVISED FAO/ILO/IMO VOLUNTARY GUIDELINES FOR THE DESIGN, CONSTRUCTION AND EQUIPMENT OF SMALL FISHING VESSELS

CHAPTER 1

GENERAL PROVISIONS

1.1 Purpose and scope

1.1.1 The purpose of these guidelines is to provide information on design, construction and equipment of small fishing vessels with a view to promoting the safety of the vessel and safety and health of the crew. They are not intended as a substitute for national laws and regulations but may serve as a guide to those concerned with framing such national laws and regulations. Each competent authority responsible for the safety of fishing vessels should ensure that the provisions of these guidelines are adapted to its specific requirements, having due regard to the size and type of vessels, their intended service and area of operation.

1.1.2 Unless otherwise stated, the provisions of these guidelines are intended to apply to new decked fishing vessels of 12 m in length and over, but less than 24 m in length. Nevertheless, even where not otherwise stated, the competent authority should as far as reasonable and practical give consideration to the application of these provisions to existing decked fishing vessels.

1.1.3 The provisions of these Voluntary Guidelines do not apply to fishing vessels for sport or recreation or to processing vessels.

1.2 Definitions

1.2.1 For the purpose of these guidelines unless expressly provided otherwise the following definitions apply:

.1 "Fishing vessel" - in the following referred to as vessel - means any vessel used commercially for catching fish, whales, seals, walrus or other living resources of the sea;

.2 "Decked vessel" is a vessel having a fixed structural deck covering the entire hull above the deepest operating waterline. Where open wells or cockpits are fitted in this deck the vessel is considered a decked vessel if flooding of the well or cockpit will not endanger the vessel;

.3 "Crew" means the skipper and all persons employed or engaged in any capacity on board a vessel on the business of that vessel;

.4 "Competent authority" is the government of the State whose flag the vessel is entitled to fly;

.5 "New vessel" is a vessel the keel of which is laid, or which is at a similar stage of construction, on or after the date of adoption of the present revision of these guidelines;

.6 "Protocol" means the Torremolinos International Convention for the Safety of Fishing Vessels, 1977, as modified by the Torremolinos Protocol of 1993 relating thereto;

.7 "Length (L)"* should be taken as 96% of the total length on a waterline at 85% of the least depth, or as the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that length is greater. In vessels designed with rake of keel the waterline on which this length is measured should be parallel to the designed waterline;

.8 "Forward and after perpendiculars" should be taken at the forward and after ends of the length (L). The forward perpendicular should be coincident with the foreside of the stem on the waterline on which the length is measured;[5]

.9 "Breadth (B)"* is the maximum breadth of the vessel, measured amidships to the moulded line of the frame in a vessel with a metal shell and to the outer surface of the hull in a vessel with a shell of any other material;

.10 "Least depth (D)"* is the depth measured from the keel line to the top of the working deck beam at side. Where the working deck is stepped and the raised part of the deck extends over the point at which the least depth is to be determined, the least depth should be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part;

.11 "Freeboard (*f*) " is the actual minimum freeboard and is the distance from the underside of the working deck at the side to a water-line, measured perpendicularly to the water-line, plus the minimum thickness of decking. When the working deck is stepped, the lowest line of the deck and the continuation of that line parallel to the upper part of the deck is to be taken as the working deck**.

.12 "Deepest operating waterline" is the waterline related to the maximum permissible operating draft;

.13 "Amidships" means the mid-length of L;

.14 "Midship section" is that section of the hull defined by the intersection of the moulded surface of the hull with a vertical plane perpendicular to the waterline and centreline plane passing through amidships[6];

.15 "Keel line" is the line parallel to the slope of keel passing amidships through:

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* Dimensions are illustrated in the Annex and when using length, breadth, depth or other dimensions for the purpose of stability examination in accordance with the guidance given in Chapter IV of Part B of the Code of Safety for Fishermen and Fishing Vessels, the definitions in that part apply.

[5] Drawn from the Protocol I.2.(6)

** Drawn from paragraph 1.2.1 (xix) of the existing Code.

[6] Drawn from the Protocol I.2.(12)

(a) the top of the keel or line of intersection of the inside of shell plating with the keel where a bar keel extends above that line of a vessel with a metal shell; or

(b) the rabbet lower line of the keel of a vessel with a shell of wood or a composite material; or

(c) the intersection of a fair extension of the outside of the shell contour at the bottom with the centreline of a vessel with a shell of material other than wood and metal;[7]

.16 "Baseline" is the horizontal line intersecting at amidships the keel line;[8]

.17 "Working deck" is generally the lowest complete deck above the deepest operating waterline from which fishing is undertaken. In vessels fitted with two or more complete decks, the competent authority may accept a lower deck as a working deck provided that that deck is situated above the deepest operating waterline;

.18 "Deck erection" is any decked structure on the working deck;

.19 "Enclosed superstructure" is a superstructure with:

.1 enclosing bulkheads of efficient construction;

.2 access openings, if any, in those bulkheads fitted with permanently attached weathertight doors of a strength equivalent to the unpierced structure which can be operated from each side; and

.3 other openings in sides or ends of the superstructure fitted with efficient weathertight means of closing.

A raised quarter-deck is regarded as a superstructure.

A bridge or poop should not be regarded as enclosed unless access is provided for the crew to reach machinery and other working spaces inside those superstructures by alternative means which are available at all times when bulkhead openings are closed;

.20 "Superstructure deck" is that complete or partial deck forming the top of a deck erection situated at a height of not less than 1.8 m above the working deck. Where this height is less than 1.8 m, the top of such deck erections should be treated in the same way as the working deck;

.21 "Height of a superstructure or other erection" is the least vertical distance measured at side from the top of the deck beams of a superstructure or an erection to the top of the working deck beams;

.22 "Weathertight" means that in any sea conditions water will not penetrate into the vessel;

[7] Drawn from the Protocol I.2.(13)
[8] Drawn from the Protocol I.2.(14)

.23 "Watertight" means capable of preventing the passage of water through the structure in any direction under a head of water for which the surrounding structure is designed;

.24 "Collision bulkhead" is a watertight bulkhead up to the working deck in the fore part of the vessel as approved by the competent authority[9]; and

.25 "Bow height" is defined as the vertical distance at the forward perpendicular between the waterline corresponding to the maximum permissible draught and the designed trim and the top of the exposed deck at side.

.26 "Organization" means the International Maritime Organization[*]; and

.27 "Approved" means approved by the competent authority.

1.3 Maintenance, upkeep and surveys

1.3.1 The hull, machinery, equipment and radio installations as well as crew accommodation of every vessel should be constructed and installed so as to be capable of being regularly maintained to ensure that they are at all times, in all respects, satisfactory for the vessel's intended service.

1.3.2 Where practicable, the competent authority should arrange for appropriate surveys of a vessel during construction and, at regular intervals after completion, to ensure satisfactory condition of the vessel's hull, machinery, equipment, radio installations equipment and radio installations as well as crew accommodation. An appropriate report of the survey should be entered in the record of the vessel.

1.3.3 After any survey has been completed no change should be made in the structural arrangements, machinery, equipment, and radio installations as well as crew accommodation etc., covered by the survey, without the approval of the competent authority.

1.3.4 Documentation relating to the safety of the vessel should cease to be valid upon transfer of the vessel to the flag of another State. New safety documentation should only be issued when the competent authority is fully satisfied that the vessel is in compliance with the requirements of the relevant provisions.

1.4 Equivalents

Where the present provisions require that a particular fitting, material, appliance or apparatus, or type thereof, shall be fitted or carried in a vessel, or that any particular provision shall be made, the competent authority may allow any other fitting, material, appliance or apparatus, or type thereof, to be fitted or carried, or any other provision to be made in that vessel, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance or apparatus, or type thereof, or provision, is at least as effective as that required by the present provisions.[**]

[9] Drawn from the Protocol I.2.(22)
[*] Drawn from Article 2 of the 1993 Torremolinos Protocol
[**] Drawn from the text of regulation I/4(1) of the Torremolinos Protocol

CHAPTER 10

SHIPBORNE NAVIGATIONAL EQUIPMENT AND ARRANGEMENTS

10.~~2~~1 Shipborne navigational equipment*

10.~~2~~1.1 Vessels should be fitted with a standard magnetic compass, except as provided in 10.~~2~~1.2. The magnetic compass should be properly adjusted and its table or curve of residual deviations should be available at all times.[274]

10.~~2~~1.2 The competent authority, if it considers it unreasonable or unnecessary to require a standard magnetic compass, may exempt individual vessels or classes of vessels from these requirements if the nature of the voyage, the vessel's proximity to land or the type of vessel does not warrant a standard compass, provided that a suitable steering compass is in all cases carried.[275]

~~10.2.3 It should be possible to read the compass by day and by night from the steering position. Magnetic compasses should be provided with means for adjustment; securing devices for compasses and compensators should be made on non magnetic materials. Compasses should be sited as near the fore-and-aft line of the vessels as practicable, with the lubber line, as accurately as possible, parallel with the fore-and-aft line.[276]~~

10.~~2.4~~1.3 In vessels equipped with an auto-pilot system actuated by a magnetic sensor, which does not indicate the vessel's heading, suitable means should be provided to show this information.[~~277~~276]

10.~~2.5~~1.4 Consideration should be given to fitting vessels with radar. In vessels where radar is fitted, the installation should be ~~to the satisfaction of the competent authority.[278]~~ capable of the operating in the 9GHz frequency band.

10.~~2.6~~1.5 Vessels should be provided with suitable means to the satisfaction of the competent authority for determining the depth of water under the vessel. Where fish-finding devices are fitted they could be used for that purpose.[~~279~~277]

10.~~2.7~~1.6 If applicable,e~~E~~very vessel should be equipped with radar reflector meeting the internationally accepted performance standards for such devices, unless the vessel is built of steel.[~~280~~278]

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* See the Recommendation on the Carriage of Electronic Position-Fixing Equipment adopted by the Organization by resolution A.156(ES.IV) and the World-Wide Radionavigation System adopted by the Organization by resolution ~~A.666(16).~~A.815(19)

[274] Please refer to regulation X/3(1), paragraphs (a)(i) and (b) of the Protocol.

[275] Please refer to regulation X/3(1)(d) of the Protocol.

[276] ~~Please refer to paragraph 9.2.2 of the existing Guidelines.~~

[~~277~~276] Please refer to paragraph 9.2.3 of the existing Guidelines.

[278] ~~Please refer to paragraph 9.2.5 of the existing Guidelines and to regulation X/3(7) of the Protocol.~~

[~~279~~277] Please refer to paragraph 9.2.4 of the existing Guidelines.

[~~280~~278] Please refer to paragraph 9.2.6 of the existing Guidelines.

10.1.7 Vessels should be fitted with a receiver for a global navigation satellite system or a terrestrial radionavigation system, or other means, suitable for use at all times throughout the intended voyage to establish and update the ship's position by automatic means. The competent authority may exempt a vessel from this requirement if it considers it unreasonable or unnecessary for such apparatus to be carried or if the vessel is provided with other radionavigation equipment suitable for use throughout its intended voyages.[279]

10.~~2.8~~1.8 All equipment fitted in compliance with this section should be ~~of a type approved by~~to the satisfaction of the competent authority.[28~~1~~0]

10.~~3~~2 Nautical ~~instruments~~ charts and nautical publications

~~Suitable nautical instruments, adequate and up-to-date charts, sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage, to the satisfaction of the competent authority, should be carried on board.[282]~~

10.2.1 Vessels should have:

.1 nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage; an electronic chart display and information system (ECDIS) may be accepted as meeting the chart carriage requirements of this subparagraph;

.2 back-up arrangements to meet the functional requirements of subparagraph .1, if this function is partly or fully fulfilled by electronic means;*

10.2.2 Nautical charts and nautical publications, such as sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage, shall be adequate and up to date.

10.3 Signalling equipment

10.3.1 Attention is drawn to the need to provide the equipment to comply in every respect with the requirements of the International Regulations for Preventing Collisions at Sea,as amended. 1972.[~~283~~281]

10.3.2 Lights, shapes and flags should be provided to indicate that the vessel is engaged in any specific operation for which such signals are used.[~~284~~282]

10.3.3 A daylight signalling lamp should be provided, the operation of which is not solely dependent upon the main source of electrical power. The power supply should in any case include a portable battery. [283]

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[279] Please refer to regulation X/3(14) of the Protocol.

[~~281~~280] Please refer to regulation X/3(16) of the Protocol.

[~~282~~] ~~Please refer to paragraph 9.3 of the existing Guidelines and to regulation X/4 of the Protocol.~~

* An appropriate folio of paper nautical charts may be used as a back-up arrangement for ECDIS. Other back-up arrangements for ECDIS are acceptable (see appendix 6 to resolution A.817(19), as amended).

[~~283~~281] Please refer to paragraph 9.4.1 of the existing Guidelines.

[~~284~~282] Please refer to paragraph 9.4.2 of the existing Guidelines.

10.3.4 All vessels which are required to carry radio installations should carry the International Code of Signals. This publication should also be carried by any other vessel which, in the opinion of the competent authority, has a need to use it.[284]

10.~~5~~4 Navigating bridge visibility

~~New vessels~~ Vessels should meet the following requirements:

.1 The view of the sea surface from the conning position should extend from right ahead to 22.5° abaft the beam on either side of the vessel. Blind sectors caused by any obstruction outside the wheelhouse should be kept as small as possible.[285]

.2 From each side of the wheelhouse, the horizontal field of vision should extend over an arc of at least 225º, that is from at least 45º on the opposite bow through right ahead and then from right ahead to right astern through 180º on the same side of the vessel.[286]

[283] Please refer to regulation X/5(1) of the Protocol.
[284] Please refer to regulation X/5(3) of the Protocol.
[285] Please refer to regulation X/6(1)(e) of the Protocol.
[286] Please refer to regulation X/6(1)(f) of the Protocol.

~~ANNEX 3~~

ANNEXES OF THE EXISTING FISHING VESSEL SAFETY CODE
~~TO BE REVIEWED BY THE NAV SUB-COMMITTEE~~

Annex VIII

RECOMMENDATION ON PERFORMANCE STANDARDS
FOR ECHO-SOUNDING EQUIPMENT*
(Valid for equipment installed before 1 January 2001)

1. Introduction

1.1 The echo-sounding equipment required by Regulation ~~12~~19 of Chapter V of the International Convention for the Safety of Life at Sea, ~~1960~~1974, as amended, should provide reliable information on the depth of water under a ship to aid navigation.

1.2 The equipment should comply with the following minimum performance requirements.

2. Range of depths

Under normal propagation conditions the equipment should be capable of measuring any clearance under the transducer between 2 metres and 400 metres.

3. Range scales

3.1 The equipment should provide a minimum of two range scales one of which, the deep range, should cover the whole range of depth, and the other, the shallow range, one tenth thereof.

3.2 The scale of display should not be smaller than 2.5 mm per metre depth on the shallow range scale and 0.25 mm per metre depth on the deep range scale.

4. Method of presentation

4.1 The primary presentation should be a graphical display which provides the immediate depth and a visible record of soundings. Other forms of display may be added but these should not affect the normal operation of the main display.

4.2 The record should, on the deep range scale, show at least 15 minutes of soundings.

4.3 Either by marks on the recording paper, or by other means, there should be a clear indication when the paper remaining is approximately 10 per cent of the length of the roll.

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* Annex of Assembly Resolution A.224(VII).

5. Illumination

Fully adequate illumination should be provided to enable identification of controls and facilitate reading of record and scales at all times. Facilities for dimming should be provided.

6. Pulse repetition rate

The pulse repetition rate should be not slower than 12 pulses per minute.

7. Accuracy of measurement

Based on a sound speed in water of 1500 metres per second, the allowable tolerance on the indicated depth should be:

either

±1 metre on the shallow range scale
±5 metres on the deep range scale

or

±5 per cent of the indicated depth, whichever is the greater.

8. Roll and pitch

The performance of the equipment should be such that it will meet the requirements of this Recommendation when the ship is rolling ±10° and/or pitching ±5°.

9. Power supply

9.1 The equipment should be capable of operating in accordance with the requirements of this Recommendation in the presence of such variations of the power supply as are normally expected in a vessel.

9.2 Means should be incorporated for the protection of the equipment from excessive currents and voltages, transients and accidental reversal of power supply polarity.

9.3 If provision is made for operating the equipment from more than one source of electrical energy, arrangements for rapidly changing from one source of supply to the other should be incorporated.

10. Interference

10.1 All reasonable and practicable steps should be taken to eliminate the causes of, and to suppress, radio interference to other equipment on board.

10.2 Mechanical noise from all units should be so limited as not to prejudice the hearing of sounds on which the safety of the ship might depend.

10.3 Each unit of the equipment should be marked with the minimum safe distances at which it may be mounted from a standard or a steering magnetic compass.

11. Durability and resistance to effects of climate

The equipment should be capable of continuous operation under the conditions of sea states, vibration, humidity and change of temperature likely to be experienced in the vessel in which it is installed.

12. Miscellaneous

12.1 The equipment should be provided with an indication of manufacturer, type and/or number.

12.2 (a) The equipment should be so constructed that it is readily accessible for maintenance purposes.

(b) Information should be provided to enable competent members of a ship's staff to operate and maintain the equipment efficiently.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR ECHO-SOUNDING EQUIPMENT*
(Valid for equipment installed on or after 1 January 2001)

1 SCOPE

The purpose of echo sounding equipment is to provide reliable information on the depth of water under a ship to aid navigation in particular in shallow water.

2 APPLICATION

Echo sounding equipment should comply with the following performance requirements. These Performance Standards are applicable for ship speeds from 0 up to 30 knots.

3 REFERENCES

- *IMO resolution A.694(17)*	*General requirements for shipborne radio equipment forming part of the GMDSS and for electronic navigational aids*
- *IMO resolution A.830(19)*	*Code on alarms and indicators*
- *SOLAS chapter V, regulation 12*	*Carriage requirements (being revised)*

4 DEFINITIONS

Sound speed in water for the purpose of this standard is set at 1500 m/s

* Annex 4 of MSC resolution MSC.74(69).

5 OPERATIONAL REQUIREMENTS

5.1 Functionality

5.1.1 Range of depth

Under normal propagation and sea bed reflectibility conditions the equipment should be capable of measuring any clearance under the transducer between 2 m and 200 m.

5.1.2 Range scales

The equipment should provide a minimum of two range scales one of which, the shallow range, should cover a range of 20 m, and the other, the deep range, should cover a range of 200 m.

5.1.3 Main display

The primary presentation should be a suitable graphical display which provides the immediate depth and a visible record of soundings. The displayed record should, show at least 15 min of soundings.

5.1.4 Other displays

Other forms of display may be added but these should not affect the normal operation of the main display.

5.1.5 Pulse repetition rate

The pulse repetition rate should not be slower than 12 pulses per minute on the deep range and 36 pulses per minute on the shallow range.

5.1.6 Roll and pitch

The performance of the equipment should be such that it will meet the requirements of these performance standards when the ship is rolling $\pm$ 10° and/or pitching $\pm$ 5°.

5.1.7 Multiple installations

5.1.7.1 More than one transducer and associated transmitter-receiver may be fitted.

5.1.7.2 If more than one transducer is used:

- means should be available to display the depths from the different transducers separately; and
- a clear indication of the transducer(s) in use should be provided.

5.1.8 **Data storage**

It should be possible to record on paper recording or other means the information about:

- the depth(s), and
- the associated time for 12 h.

There should be means to retrieve the recorded information.

5.2 Accuracy

5.2.1 **Accuracy of measurement**

Based on a sound speed in water of 1,500 m/s, the tolerance of the indicated depth should be either:

- $\pm$ 0.5 m on the 20 m range scale, respectively $\pm$ 5 m on the 200 m range scale; or
- $\pm$ 2.5% of the indicated depth,

whichever is greater.

5.2.2 **Discrimination**

The scale of display should not be smaller than 5.0 mm per metre depth on the shallow range scale and 0.5 mm per metre depth on the deep range scale.

5.3 Malfunctions, alarms and indications

5.3.1 **Depth alarm**

An alarm signal - both visual and audible with mute function - should be provided when the water depth is below a preset value.

5.3.2 **Failure or reduction in power supply**

Alarm signals, both visual and audible (with mute function) to the navigator on the watch should be provided to indicate failure or a reduction in the power supply to the echo sounder which would affect the safe operation of the equipment.

6 ERGONOMIC CRITERIA

6.1 Operational controls

The function of range scale selection should be directly accessible.

The settings for the following functions should be recognizable in all light conditions:

- range scale; and
- preset depth alarm.

6.2 Presentation of information

6.2.1 Marks

The graphical display should be capable of showing:

- depth marks at intervals not larger than one-tenth of the range/scale in use; and
- time marks at intervals not exceeding 5 min.

6.2.2 Paper recording

If paper is used for recording either by marks on the recording paper, or by other means, there should be a clear indication when the paper remaining is less than 1 m.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR GYRO-COMPASSES*

1 INTRODUCTION

1.1 The gyro-compass required by Regulation ~~12~~19 of Chapter V of the International Convention for the Safety of Life at Sea, 1974, should determine the direction of the ship's head in relation to geographic (true) north.

1.2 The equipment should comply with the following minimum performance requirements.

2 DEFINITIONS

For the purpose of this recommendation, the following definitions apply:

.1 The term "gyro-compass" comprises the complete equipment and includes all essential elements of the complete design.

.2 The "true heading" is the horizontal angle between the vertical plane passing through the true meridian and the vertical plane passing through the ship's fore and aft datum line. It is measured from true north (000º) clockwise through 360º.

.3 The compass is said to be "settled" if any three readings taken at intervals of thirty minutes, when the compass is on a level and stationary base, are within a band of 0.7º.

.4 The "settle point heading" is the mean value of ten readings taken at twenty minute intervals after the compass has settled as defined in paragraph 2.3.

.5 The "settle point error" is the difference between settle point heading and true heading.

.6 The other errors to which the gyro-compass is subject are taken to be the difference between the observed value and the settle point heading.

3 METHOD OF PRESENTATION

The compass card should be graduated in equal intervals of one degree or a fraction thereof. A numerical indication should be provided at least at every ten degrees, starting from 000º clockwise through 360º.

4 ILLUMINATION

Full adequate illumination should be provided to enable reading of scales at all times. Facilities for dimming should be provided.

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* Annex of Assembly resolution A.~~280(VIII).~~ 424(XI)

5 ACCURACY

5.1 Settling of equipment

5.1.1 When switched on in accordance with the manufacturer's instructions the compass should settle within six hours in latitudes of up to 60º.

5.1.2 The settle point error as defined in paragraph 2.5 at any heading and at any latitude up to 60º should not exceed ± 0.75 x secant latitude where heading indications of the compass should be taken as the mean of 10 readings at 20 minute intervals, and the root mean square value of the differences between individual heading indications and the mean should be less than 0.25º x secant latitude. The repeatability of settle point error from one run-up to another shall be within 0.25º x secant latitude.

5.2 Performance under operational conditions

5.2.1 When switched on in accordance with the manufacturer's instructions, the compass should settle within six hours in latitudes of up to 60º when rolling and pitching with simple harmonic motion of any period between six and fifteen seconds, a maximum angle of 5º, and a maximum horizontal acceleration of 0.22 m/s^2.

5.2.2 The repeatability of the settle point error of the master compass shall be within ± 1º x secant latitude under the general conditions mentioned in paragraphs 6.1 and 8 and including variations in magnetic field likely to be experienced in the ship in which it is installed.

5.2.3 In latitudes of up to 60º:

.1 the residual steady state error, after correction for speed and course influences at a speed of twenty knots, shall not exceed ± 0.25 x secant latitude;

.2 the error due to a rapid alteration of speed of twenty knots should not exceed ± 2º;

.3 the error due to a rapid alteration of course of 180º at a speed of twenty knots should not exceed ± 3º;

.4 the transient and steady state errors due to the ship rolling, pitching and yawing, with simple harmonic motion of any period between six and fifteen seconds, maximum angle of 20º, 10º and 5º respectively, and maximum horizontal acceleration not exceeding 1 m/s^2, should not exceed 1º x secant latitude.

5.2.4 The maximum divergence in reading between the master compass and repeaters under all operational conditions should not exceed ± 0.5º.

Note: When the compass is used for purposes other than steering and bearing, a higher accuracy might be necessary.
To ensure that the maximum error referred to in subparagraph 5.2.3.4 is not exceeded in practice, it will be necessary to pay particular attention to the siting of the master compass.

6 POWER SUPPLY

6.1 The equipment should be capable of operating continuously in accordance with the requirements of this recommendation in the presence of such variations of the power supply as are normally expected in a ship.

6.2 Means should be incorporated for the protection of the equipment from excessive currents and voltages, transients and accidental reversal of power supply polarity.

6.3 If provision is made for operating the equipment from more than one source of electrical energy, arrangements for rapidly changing from one source of supply to the other should be incorporated.

7 INTERFERENCE

7.1 All steps should be taken to eliminate as far as practicable the causes of, and to suppress, electromagnetic interference between the gyro-compass and other equipment on board.

7.2 Mechanical noise from all units should be so limited as not to prejudice the hearing of sounds on which the safety of the ship might depend.

7.3 Each unit of the equipment should be marked with the minimum safe distances at which it may be mounted from a standard or a steering magnetic compass.

8 DURABILITY AND RESISTANCE TO EFFECTS OF CLIMATE

The equipment should be capable of continuous operation under the conditions of vibration, humidity and change of temperature likely to be experienced in the ship in which it is installed.

9 CONSTRUCTION AND INSTALLATION

9.1 The master compass and any repeaters used for taking visual bearing should be installed in a ship with their force and aft datum lines parallel to the ship's fore and aft datum line to within ± 0.5º. The lubber line should be in the same vertical plane as the centre of the card of the compass and should be aligned accurately in the fore and aft direction.

9.2 Means should be provided for correcting the errors induced by speed and latitude.

9.3 An automatic alarm should be provided to indicate a major fault in the compass system.

9.4 The system should be designed to enable heading information to be provided to other navigational aids such as radar, radio direction-finder and automatic pilot.

9.5 Information should be provided to enable competent members of a ship's staff to operate and maintain the equipment efficiently.

9.6 The equipment should be provided with an indication of manufacturer, type and/or number.

9.7 The equipment should be so constructed and installed that it is readily accessible for maintenance purposes.

10 DESIGN AND INSTALLATION

The equipment should comply with IMO resolution A.694(17).*

11 INTERFACING

Output(s) should be available from which depth information may be supplied to other equipment such as remote digital displays, voyage data recorder and a track control system.

These outputs should be digital, serial communication, facilities which should comply with the relevant international standards.**

~~**1. Introduction**~~

~~1.1 The gyro-compass required by Regulation 12 of Chapter V of the International Convention for the Safety of Life at Sea, 1960, as amended, should determine the direction of the ship's head in relation to geographic (true) north.~~

~~1.2 The equipment should comply with the following minimum performance requirements.~~

~~**2. Definitions**~~

~~For the purpose of this Recommendation, the following definitions apply:~~

~~(a) The term "gyro-compass" comprises the complete equipment and includes all essential elements of the complete design.~~

~~(b) The "true heading" is the horizontal angle between the vertical plane passing through the true meridian and the vertical plane passing through the ship's fore and aft datum line. It is measured from True North (000°) clockwise through 360°.~~

~~(c) The compass is said to be "settled" if any three readings taken at intervals of 30 minutes (when the compass is on a stationary base) are within a band of 0.7 degrees.~~

~~(d) The "settle point heading" is the average value of three readings taken at 30 minute intervals after the compass has settled.~~

~~(e) The "settle point error" is the difference between settle point heading and true heading.~~

*IEC 945

**IEC 1162

(f) The errors to which the gyro-compass is subject are considered to have a probability of 68.3 per cent, where the errors are taken as differences between the observed values and their mean value.

The "maximum error" is understood as triple the above error and has a probability of 99.7 per cent.

3. Method of presentation

The compass card should be graduated in equal intervals of one degree or a fraction thereof. A numerical indication should be provided at least at every ten degrees, starting from 000° clockwise through 360°.

4. Illumination

Fully adequate illumination should be provided to enable reading of scales at all times. Facilities for dimming should be provided.

5. Accuracy

5.1 ***Settling time of equipment***

The compass should settle within six hours of switching on in latitudes of up to 70°.

5.2 ***Performance under operational conditions***

(a) The maximum value of the settle point error of the master compass should not exceed ±2° in the general conditions mentioned in paragraphs 6.1 and 8 and including variations in magnetic field likely to be experienced in the vessel in which it is installed.

(b) The maximum error of the master compass in latitudes up to 70° should not exceed:

(i) ±1° when the ship is travelling on a straight course at a constant speed in conditions of calm sea;

(ii) ±2.5° due to a rapid alteration of course of 180° at speeds up to 20 knots;

(iii) ±2° due to a fast alteration of speed of 20 knots;

(iv) ±3° when rolling and pitching with any period between 3 and 15 seconds, a maximum angle of 22.5° and a maximum horizontal acceleration of 3 m/s^2.

(c) The maximum divergence in reading between the master compass and repeaters should not exceed ±0.3° under the conditions mentioned in paragraph 5.2(a).

~~***Note***: When the compass is used for purposes other than steering and bearing, a higher accuracy might be necessary.~~

~~To ensure that the maximum error referred to in sub-paragraph (b)(iv) is not exceeded in practice, it will be necessary to pay particular attention to the siting of the master compass.~~

~~6. Power supply~~

~~6.1 The equipment should be capable of operating continuously in accordance with the requirements of this Recommendation in the presence of such variations of the power supply as are normally expected in a vessel.~~

~~6.2 Means should be incorporated for the protection of the equipment from excessive currents and voltages, transients and accidental reversal of power supply polarity.~~

~~6.3 If provision is made for operating the equipment from more than one source of electrical energy, arrangements for rapidly changing from one source of supply to the other should be incorporated.~~

~~7. Interference~~

~~7.1 All steps should be taken to eliminate as far as practicable the causes of, and to suppress, electromagnetic interference between the gyro-compass and other equipment on board.~~

~~7.2 Mechanical noise from all units should be so limited as not to prejudice the hearing of sounds on which the safety of the ship might depend.~~

~~7.3 Each unit of the equipment should be marked with the minimum safe distances at which it may be mounted from a standard or a steering magnetic compass.~~

~~8. Durability and resistance to effects of climate~~

~~The equipment should be capable of continuous operation under the conditions of vibration, humidity and change of temperature likely to be experienced in the vessel in which it is installed.~~

~~9. Construction and installation~~

~~9.1 The master compass and any repeaters used for taking visual bearings should be installed in a ship with their fore and aft datum lines parallel to the ship's fore and aft datum line to within ±0.5°. The lubber line should be in the same vertical plane as the centre of the card of the compass and should be aligned accurately in the fore and aft direction.~~

~~9.2 Means should be provided for correcting the errors induced by speed and latitude.~~

~~9.3 An automatic alarm should be provided to indicate a major fault in the compass system.~~

~~9.4 The system should be designed to enable heading information to be provided to other navigational aids such as radar, radio direction-finder and automatic pilot.~~

~~9.5 Information should be provided to enable competent members of a ship's staff to operate and maintain the equipment efficiently.~~

~~9.6 The equipment should be provided with an indication of manufacture, type and/or number.~~

~~9.7 The equipment should be so constructed and installed that it is readily accessible for maintenance purposes.~~

RECOMMENDATION ON GENERAL REQUIREMENTS FOR SHIPBORNE RADIO EQUIPMENT FORMING PART OF THE GMDSS AND FOR ELECTRONIC NAVIGATIONAL AIDS*

1 INTRODUCTION

1.1 Equipment, which:

.1 forms part of the global maritime distress and safety system; or

.2 is required by regulation V/12 of the 1974 SOLAS Convention as amended and other electronic navigational aids, where appropriate;

should comply with the following general requirements and with all applicable performance standards adopted by the Organization.

1.2 Where a unit of equipment provides a facility which is additional to the minimum requirements of this Recommendation, the operation and, as far as is reasonably practicable, the malfunction of such additional facility should not degrade the performance of the equipment specified in 1.1.

2 INSTALLATION

Equipment should be installed in such a manner that it is capable of meeting the requirements of 1.1.

3 OPERATION

3.1 The number of operational controls, their design and manner of function, location, arrangement and size should provide for simple, quick and effective operation. The controls should be arranged in a manner which minimizes the chance of inadvertent operation.

3.2 All operational controls should permit normal adjustments to be easily performed and should be easy to identify from the position at which the equipment is normally operated. Controls not required for normal operation should not be readily accessible.

3.3 Adequate illumination should be provided in the equipment or in the ship to enable identification of controls and facilitate reading of indicators at all times. Means should be provided for dimming the output of any equipment light source which is capable of interfering with navigation.

3.4 The design of the equipment should be such that misuse of the controls should not cause damage to the equipment or injury to personnel.

3.5 If a unit of equipment is connected to one or more other units of equipment the performance of each should be maintained.

* Annex of Assembly Resolution A.694(17)

3.6 Where a digital input panel with the digits 0 to-9 is provided, the digits should be arranged to conform with relevant CCITT recommendations.* However, where an alphanumeric keyboard layout, as used on office machinery and data processing equipment, is provided, the digits 0 to 9 may, alternatively, be arranged to conform with the relevant ISO standard.**

4 POWER SUPPLY

4.1 Equipment should continue to operate in accordance with the requirements of this Recommendation in the presence of variations of power supply normally to be expected in a ship.

4.2 Means should be incorporated for the protection of equipment from the effects of excessive current and voltage, transients and accidental reversal of the power supply polarity.

4.3 If provision is made for operating equipment from more than one source of electrical energy, arrangements for rapidly changing from one source to the other should be provided but not necessarily incorporated in the equipment.

5 DURABILITY AND RESISTANCE TO ENVIRONMENTAL CONDITIONS

Equipment should be capable of continuous operation under the conditions of various sea states, ship's motion, vibration, humidity and temperature likely to be experienced in ships.***

6 INTERFERENCE

6.1 All reasonable and practicable steps should be taken to ensure electromagnetic compatibility between the equipment concerned and other radiocommunication and navigational equipment carried on board in compliance with the relevant requirements of chapter IV and chapter V of the 1974 SOLAS Convention. ****

6.2 Mechanical noise from all units should be limited so as not to prejudice the hearing of sounds on which the safety of the ship might depend.

6.3 Each unit of equipment normally to be installed in the vicinity of a standard compass or a magnetic steering compass should be clearly marked with the minimum safe distance at which it may be mounted from such compasses.

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* CCITT Recommendation E161/Q.11
** ISO Standard 3791.
*** IEC Publications 92-101 and 945.
**** IEC Publications 533 and 945.

7 SAFETY PRECAUTIONS

7.1 As far as is practicable, accidental access to dangerous voltages should be prevented. All parts and wiring in which the direct or alternating voltages or both (other than radio frequency voltages) combine to give a peak voltage greater than 55 V should be protected against accidental access and should be isolated automatically from all sources of electrical energy when the protective covers are removed. Alternatively, the equipment should be so constructed that access to such voltages may only be gained after having used a tool for this purpose, such as spanner or screwdriver, and warning labels should be prominently displayed both within the equipment and on protective covers.

7.2 Means should be provided for earthing exposed metallic parts of the equipment but this should not cause any terminal of the source of electrical energy to be earthed.

7.3 All steps should be taken to ensure that electromagnetic radio frequency energy radiated from the equipment shall not be a hazard to personnel.

7.4 Equipment containing elements such as vacuum tubes which are likely to cause X-radiation should comply with the following requirements:

.1 external X-radiation from the equipment in its normal working condition should not exceed the limits laid down by the Administration concerned;

.2 when X-radiation can be generated inside the equipment above the levels laid down by the Administration, a prominent warning should be fixed inside the equipment and the precautions to be taken when working on the equipment should be included in the equipment manual; and

.3 if malfunction of any part of the equipment can cause an increase in X-radiation, adequate advice should be included in the information about the equipment, warning of the circumstances which could cause the increase and stating the precautions which should be taken.

8 MAINTENANCE

8.1 The equipment should be so designed that the main units can be replaced readily, without elaborate recalibration or readjustment.

8.2 Equipment should be so constructed and installed that it is readily accessible for inspection and maintenance purposes.

8.3 Adequate information should be provided to enable the equipment to be properly operated and maintained. The information should:

.1 in the case of equipment so designed that fault diagnosis and repair down to component level are practicable, provide full circuit diagrams, component layouts and a component parts list; and

.2 in the case of equipment containing complex modules in which fault diagnosis and repair down to component level are not practicable, contain sufficient information to enable a defective complex module to be located, identified and replaced. Other modules and those discrete components which do not form part of modules should also meet the requirements of .1 above.

9 MARKING AND IDENTIFICATION

Each unit of the equipment should be marked externally with the following information which should be clearly visible in the normal installation position:

.1 identification of the manufacturer;

.2 equipment type number or model identification under which it was type tested; and

.3 serial number of the unit.

RECOMMENDATION ON PERFORMANCE STANDARD FOR MAGNETIC COMPASSES *

1 DEFINITIONS

1.1 A *magnetic compass* is an instrument designed to seek a certain direction in azimuth and to hold that direction permanently, and which depends, for its directional properties, upon the magnetism of the earth.

1.2 The *standard compass* is a magnetic compass used for navigation, mounted in a suitable binnacle containing the required correcting devices and equipped with a suitable azimuth reading device.

1.3 The *steering compass* is a magnetic compass used for steering purposes mounted in a suitable binnacle containing the required correcting devices.

Note: If the transmitted image of a sector of the standard compass card of at least 15° to each side of the lubber mark is clearly readable for steering purposes at the main steering position, both in daylight and artificial light according to sub-paragraph 7.1, the standard compass can also be regarded as the steering compass.

2 COMPASS CARD

2.1 The compass card should be graduated in 360 single degrees. A numerical indication should be provided every 10°, starting from North (000°) clockwise to 360°. The cardinal points should be indicated by the capital letters N, E, S and W. The North point may instead be indicated by a suitable emblem.

2.2 The directional error of the card, composed of inaccuracies in graduation, eccentricity of the card on its pivot and inaccuracy of orientation of the card on the magnetic system should not exceed 0.5° on any heading.

2.3 The card of the steering compass should clearly be readable both in daylight and artificial light at a distance of 1.4 m. The use of a magnifying glass is permitted.

3 MATERIALS

3.1 The magnets used in the directional system and the corrector magnets for correcting the permanent magnetic fields of the ship should have a high coercivity of at least 11.2 kA/m.

3.2 Material used for correcting induced fields should have a low remanence and coercivity.

3.3 All other materials used in the magnetic compass and in the binnacle should be non-magnetic, so far as reasonable and practicable and such that the deviation of the card caused by these materials should not exceed $\left(\frac{9}{H}\right)^{\circ}$, where H is the horizontal component of the magnetic flux density in μT (micro Tesla) at the place of the compass.

* Annex of Assembly resolution A.382(X)

4 PERFORMANCE

The magnetic compass equipment should operate satisfactorily and remain usable under the operational and environmental conditions likely to be experienced on board ships in which it is installed.

5 CONSTRUCTIONAL ERROR

5.1 With the compass rotating at a uniform speed of 1.5°/s and a temperature of the compass of 20°C $\pm$ 3°C the deflection of the card should not exceed $\left(\frac{36}{H}\right)$ °, if the diameter of the card is less than 200 mm. If the diameter of the compass card is 200 mm or more, the deflection of the card should not exceed $\left(\frac{54}{H}\right)$°; H being defined as in subparagraph 3.3.

5.2 The error due to friction should not exceed$\left(\frac{3}{H}\right)$ °, at a temperature of 20°C $\pm$ 3°C; H being defined as in subparagraph 3.3.

5.3 With a horizontal component of the magnetic field of 18 μT the half period of the card should be at least 12 s, after an initial deflection of 40°. The time taken to return finally to within $\pm$ 1° of the magnetic meridian should not exceed 60 s after an initial deflection of 90°. Aperiodic compasses shall comply with the latter requirements only.

6 CORRECTING DEVICES

6.1 The binnacle should be provided with devices for correcting semicircular and quadrantal deviation due to:

(a) the horizontal components of the ship's permanent magnetism;

(b) heeling error;

(c) the horizontal component of the induced horizontal magnetism;

(d) the horizontal component of the induced vertical magnetism.

6.2 The correcting devices provided in subparagraph 6.1 should ensure that no serious changes of deviation occur under the influence of the conditions described in paragraph 4 and particularly considerable alteration of magnetic latitude. Sextantal and deviations of higher order should be negligible.

7 CONSTRUCTION

7.1 Primary and emergency illumination should be installed so that the card may be read at all times. Facilities for dimming should be provided.

7.2 With the exception of the illumination, no electrical power supply should be necessary for operating the magnetic compass.

7.3 In the case where an electrical reproduction of the indication of the standard compass is regarded as a steering compass, the transmitting system should be provided with both primary and emergency electrical power supply.

7.4 Equipment should be constructed and installed in such a way that it is easily accessible for correcting and maintenance purposes.

7.5 The compass, binnacle and azimuth reading device should be marked to the satisfaction of the Administration.

7.6 The standard compass should be suspended in gimbals so that its verge ring remains horizontal when the binnacle is tilted up to 40° in any direction, and so that the compass cannot be dislodged under any condition of sea or weather. Steering compasses suspended in gimbals should meet the same requirements. If they are not suspended in gimbals they should have a freedom of the card of at least 30^{o} in all directions.

7.7 Material used for the manufacture of magnetic compasses should be of sufficient strength and be to the satisfaction of the Administration.

8 POSITIONING

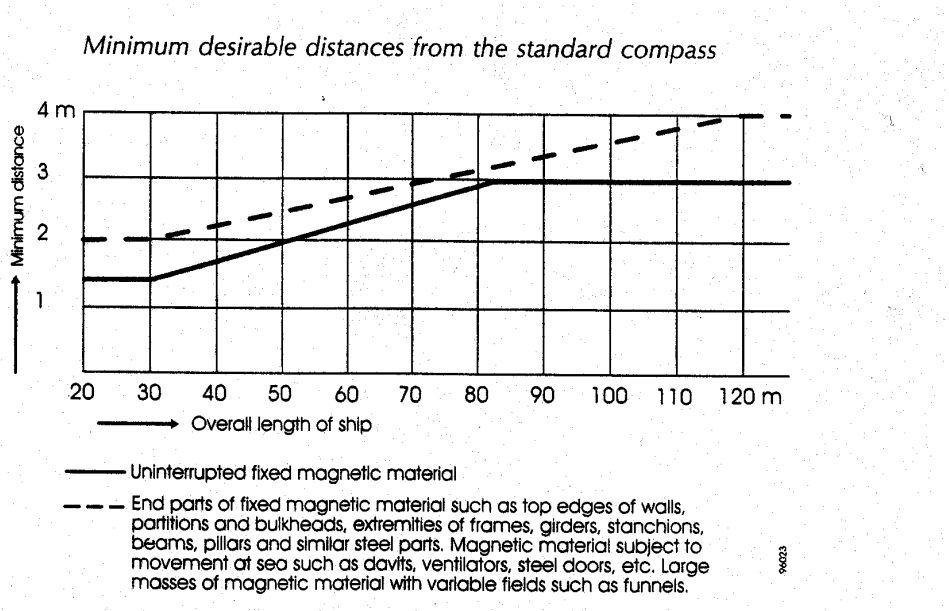
8.1 The magnetic compass equipment should be installed if practicable and reasonable on the ship's centreline. The main lubber mark should indicate the ship's heading with an accuracy of $\pm$ 0.5°.

8.2 The standard compass should be installed so that from its position the view is as uninterrupted as possible, for the purpose of taking horizontal and celestial bearings. The steering compass should be clearly readable by the helmsman at the main steering position.

8.3 The magnetic compasses should be installed as far as possible from magnetic material.

The minimum distances of the standard compass from any magnetic material which is part of the ship's structure should be to the satisfaction of the Administration. The following diagram gives general guidelines to indicate the minimum desirable distances from the standard compass.

The minimum desirable distances for the steering compass may be reduced to 65% of the values given by the diagram provided that no distance is less than 1 m. If there is only a steering compass the minimum distances for the standard compass should be applied as far as practicable.



8.4 The distance of the magnetic compass from electrical or magnetic equipment should be at least equal to the safe distance specified for the equipment and be to the satisfaction of the Administration.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR RADAR EQUIPMENT*

Valid for equipment installed before 1 September 1984

1 The radar equipment required by regulation 12 of chapter V should provide an indication in relation to the ship of the position of other surface craft and obstructions and of buoys, shorelines and navigational aids in a manner which will assist in avoiding collision and in navigation.

2 It should comply with the following minimum requirements:

(a) **Range performance**

The operational requirement under normal propagation conditions, when the radar aerial is mounted at a height of 15 m above sea level, is that the equipment should give a clear indication of:

(i) *Coastlines*

At 20 nautical miles when the ground rises to 60 m.
At 7 nautical miles when the ground rises to 6 m.

(ii) *Surface objects*

At 7 nautical miles a ship of 5,000 tons gross tonnage, whatever her aspect.

At 3 nautical miles a small vessel of length 10 m.

At 2 nautical miles an object such as a navigational buoy having an effective echoing area of approximately 10 m^2.

(b) **Minimum range**

The surface objects specified in paragraph 2(a)(ii) of this Recommendation should be clearly displayed from a minimum range of 50 m up to a range of 1 nautical mile, without adjustment of controls other than the range selector.

(c) **Display**

(i) The equipment should provide a relative plan display of not less than 180 mm effective diameter.

(ii) The equipment should be provided with at least five ranges, the smallest of which is not more than 1 nautical mile and the greatest of which is not less than 24 nautical miles. The scales should be preferably of 1:2 ratio. Additional ranges may be provided.

* Annex of Assembly resolution A.222(VII)

(iii) Positive indication should be given of the range of view displayed and the interval between range rings.

(d) **Range measurement**

(i) The primary means provided for range measurement should be fixed electronic range rings. There should be at least four range rings displayed on each of the ranges mentioned in paragraph 2(c)(ii), except that on ranges below 1 nautical mile range rings should be displayed at intervals of 1/4 nautical mile.

(ii) Fixed range rings should enable the range of an object, whose echo lies on a range ring, to be measured with an error not exceeding 1.5% of the maximum range of the scale in use, or 70 m, whichever is the greater.

(iii) Any additional means of measuring range should have an error not exceeding 2.5% of the maximum range of the displayed scale in use, or 120 m, whichever is the greater.

(e) **Heading indicator**

(i) The heading of the ship should be indicated by a line on the display with a maximum error not greater than $\pm 1°$. The thickness of the displayed heading line should not be greater than ½°.

(ii) Provision should be made to switch off the heading indicator by a device which cannot be left in the "heading marker off" position.

(f) **Bearing measurement**

(i) Provision should be made to obtain quickly the bearing of any object whose echo appears on the display.

(ii) The means provided for obtaining bearings should enable the bearing of a target whose echo appears at the edge of the display to be measured with an accuracy of $\pm$ 1° or better.

(g) **Discrimination**

(i) The equipment should display as separate indications, on the shortest range scale provided, two objects on the same azimuth separated by not more than 50 m in range.

(ii) The equipment should display as separate indications two objects at the same range separated by not more than 2.5° in azimuth.

(iii) The equipment should be designed to avoid, as far as is practicable, the display of spurious echoes.

(h) **Roll**

The performance of the equipment should be such that when the ship is rolling ± 10° the echoes of targets remain visible on the display.

The scan should be continuous, and automatic through 360° of azimuth.

The target data rate should be at least 12 per minute. The equipment should operate satisfactorily in relative wind speeds of up to 100 knots.

j) **Azimuth stabilization**

(i) Means should be provided to enable the display to be stabilized in azimuth by a transmitting compass. The accuracy of alignment with the compass transmission should be within ½° with a compass rotation rate of 2 r.p.m.

(ii) The equipment should operate satisfactorily for relative bearings when the compass control is inoperative or not fitted.

(k) **Performance check**

Means should be available, while the equipment is used operationally, to determine readily a significant drop in performance relative to a calibration standard established at the time of installation.

(l) **Anti-clutter devices**

Means should be provided to minimize the display of unwanted responses from precipitation and the sea.

(m) **Operation**

(i) The equipment should be capable of being switched on and operated from the main display position.

(ii) Operational controls should be accessible and easy to identify and use.

(iii) After switching on from cold, the equipment should become fully operational within 4 min.

(iv) A standby condition should be provided from which the equipment can be brought to a fully operational condition within 1 min.

(v) The equipment should continue to operate in accordance with the requirements of this Recommendation in the presence of variations of the power supply normally to be expected in a vessel.

(n) **Interference**

(i) All steps should be taken to eliminate as far as practicable the causes of, and to suppress, radio interference between the radar equipment and other equipment on board.

(ii) Mechanical noise from all units should be so limited as not to prejudice the hearing of sounds on which the safety of the ship might depend.

(iii) Each unit of the equipment normally installed in the vicinity of a standard or a steering magnetic compass should be clearly marked with the minimum distances at which it may be mounted.

(iv) After installation and adjustment on board, the bearing accuracy as prescribed in this Recommendation should be maintained without further adjustment irrespective of the variation of external magnetic fields.

(o) **Sea or ground stabilization**

Sea or ground stabilization, if provided, should not degrade the accuracy of the display below the requirements of this Recommendation, and the view ahead on the display should not be unduly restricted by the use of this facility.

(p) **Durability and resistance to effects of climate**

The radar equipment should be capable of continued operation under the conditions of vibration, humidity and change of temperature likely to be experienced in the vessel in which it is installed.

3 The aerial system should be installed in such a manner that the efficiency of the display is not impaired by the close proximity of the aerial to other objects. In particular, blind sectors in the forward direction should be avoided.

SUPPLEMENT TO THE RECOMMENDATION ON PERFORMANCE STANDARDS FOR NAVIGATIONAL RADAR EQUIPMENT*

RECOMMENDATION ON SYMBOLS FOR CONTROLS ON MARINE NAVIGATIONAL RADAR EQUIPMENT

1 LIST OF CONTROLS TO BE SYMBOLIZED

The following switches and variable controls are considered to be the minimum required to be marked by symbols:

Radar on - standby - off switch

Aerial rotation switch

Mode of presentation switch - north up or ship's head up

Heading marker alignment control or switch

Range selection switch

Pulse length selection switch - short or long pulse

Tuning control

Gain control

Anti-clutter rain control (differentiation)

Anti-clutter sea control

Scale illumination control or switch

Display brilliance control

Range rings brilliance control

Variable range marker control

Bearing marker control

Performance monitor switch - transmitted power monitor or transmit/receive monitor.

* Annex of Assembly Resolution A.222(VII)

2 CODE OF PRACTICE

The following code of practice should be used when marking radar sets with recommended symbols:

2.1 The maximum dimension of a symbol should not be less than 9 mm.

2.2 The distance between the centres of two adjacent symbols should be not less than 1.4 times the size of the larger symbol.

2.3 Switch function symbols should not be linked by a line. A linked line infers controlled action.

2.4 Variable control function symbols should be linked by a line, preferably an arc. The direction of increase of controlled function should be indicated.

2.5 Symbols should be presented with a high contrast against their background.

2.6 The various elements of a symbol should have a fixed ratio one to another.

2.7 Multiple function of controls and switch positions may be indicated by a combined symbol.

2.8 Where concentric controls or switches are fitted, the outer of the symbols should refer to the larger diameter control.

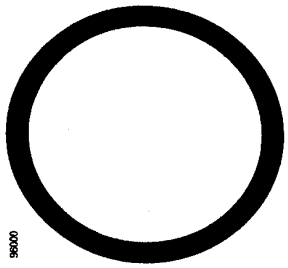
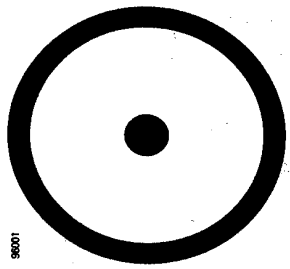
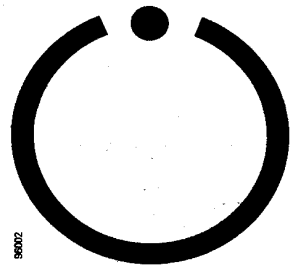
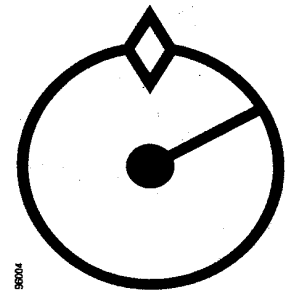
3 SYMBOLS

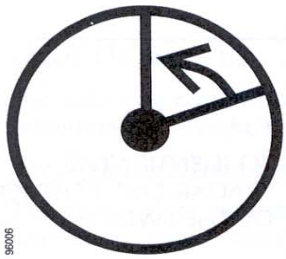
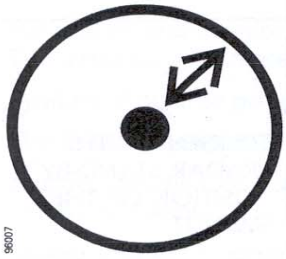
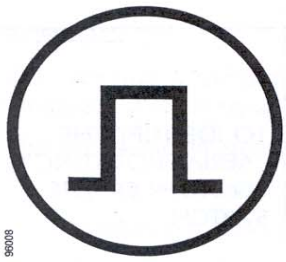
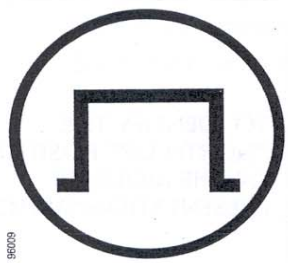
3.1 The symbols attached hereto should be used for controls on marine navigational radar equipment.

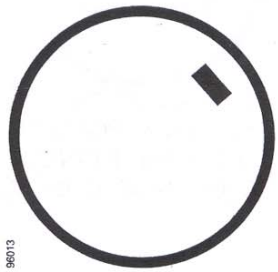
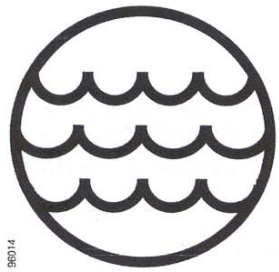
3.2 The circles shown around the following symbols are optional:

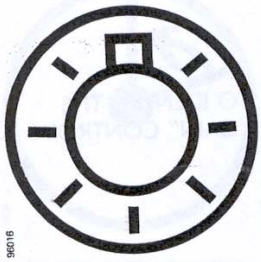
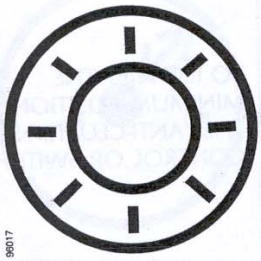
Symbol 4: aerial rotating
Symbol 9: short pulse
Symbol 10: long pulse
Symbol 17: scale illumination
Symbol 22: transmitted power monitor
Symbol 23: transmit/receive monitor.

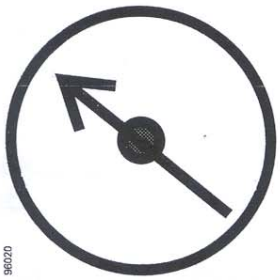
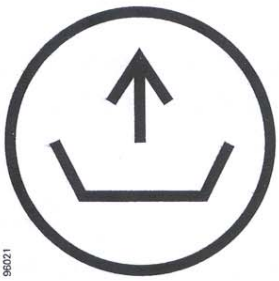
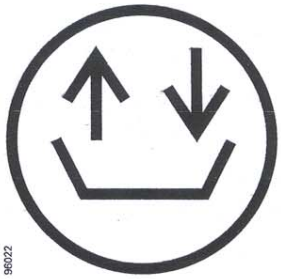
SYMBOLS FOR CONTROLS ON MARINE NAVIGATIONAL RADAR EQUIPMENT

1		OFF	TO IDENTIFY THE "OFF" POSITION OF THE CONTROL OR SWITCH
2		RADAR ON	TO IDENTIFY THE "RADAR ON" POSITION OF THE SWITCH
3		RADAR STAND-BY	TO IDENTIFY THE "RADAR STAND-BY" POSITION OF THE SWITCH
4		AERIAL ROTATING	TO IDENTIFY THE "AERIAL ROTATING" POSITION OF THE SWITCH
5		NORTH UP PRESENTATION	TO IDENTIFY THE "NORTH UP" POSITION OF THE MODE OF PRESENTATION SWITCH

6		SHIP'S HEAD UP PRESENTATION	TO IDENTIFY THE "SHIP'S HEAD UP" POSITION OF THE MODE OF PRESENTATION SWITCH
7		HEADING MARKER ALIGNMENT	TO IDENTIFY THE "HEADING MARKER ALIGNMENT" CONTROL SWITCH
8		RANGE SELECTOR	TO IDENTIFY THE RANGE SELECTION SWITCH
9		SHORT PULSE	TO IDENTIFY THE "SHORT PULSE" POSITION OF THE PULSE LENGTH SELECTION SWITCH
10		LONG PULSE	TO IDENTIFY THE "LONG PULSE" POSITION OF THE PULSE LENGTH SELECTION SWITCH

11		TUNING	TO IDENTIFY THE "TUNING" CONTROL
12		GAIN	TO IDENTIFY THE "GAIN" CONTROL
13		ANTI-CLUTTER RAIN MINIMUM	TO IDENTIFY THE MINIMUM POSITION OF THE "ANTI-CLUTTER RAIN" CONTROL OR SWITCH
14		ANTI-CLUTTER RAIN MAXIMUM	TO IDENTIFY THE MAXIMUM POSITION OF THE "ANTI-CLUTTER RAIN" CONTROL OR SWITCH
15		ANTI-CLUTTER SEA MINIMUM	TO IDENTIFY THE MINIMUM POSITION OF THE "ANTI-CLUTTER SEA" CONTROL

16	 96015	ANTI-CLUTTER SEA MAXIMUM	TO IDENTIFY THE MAXIMUM POSITION OF THE "ANTI-CLUTTER SEA" CONTROL
17	 96016	SCALE ILLUMINATION	TO IDENTIFY THE MAXIMUM POSITION OF THE "SCALE ILLUMINATION" CONTROL OR SWITCH
18	 96017	DISPLAY BRILLIANCE	TO IDENTIFY THE MAXIMUM POSITION OF THE "DISPLAY BRILLIANCE" CONTROL
19	 96018	RANGE RINGS BRILLIANCE	TO IDENTIFY THE MAXIMUM POSITION OF THE "RANGE RINGS BRILLIANCE" CONTROL
20	 96019	VARIABLE RANGE MARKER	TO IDENTIFY THE "VARIABLE RANGE MARKER" CONTROL

21		BEARING MARKER	TO IDENTIFY THE "BEARING MARKER" CONTROL
22		TRANSMITTED POWER MONITOR	TO IDENTIFY THE ON POSITION OF THE "TRANSMITTED POWER MONITOR" SWITCH
23		TRANSMIT/ RECEIVE MONITOR	TO IDENTIFY THE ON POSITION OF THE "TRANSMIT/RECEIVE MONITOR" SWITCH

RECOMMENDATION ON PERFORMANCE STANDARDS FOR RADAR EQUIPMENT*

Valid for equipment installed between 1 September 1984 and 31 December 1998

1 APPLICATION

1.1 This Recommendation applies to all ships' radar equipment installed on or after 1 September 1984 in compliance with regulation 12, chapter V, of the International Convention for the Safety of Life at Sea, 1974, as amended.

1.2 Radar equipment installed before 1 September 1984 should comply at least with the performance standards recommended in resolution A.222(VII).

2 GENERAL

The radar equipment should provide an indication, in relation to the ship, of the position of other surface craft and obstructions and of buoys, shorelines and navigational marks in a manner which will assist in navigation and in avoiding collision.

3 ALL RADAR INSTALLATIONS

All radar installations should comply with the following minimum requirements.

3.1 Range performance

The operational requirement under normal propagation conditions, when the radar antenna is mounted at a height of 15 m above sea level, is that the equipment should in the absence of clutter give a clear indication of:

.1 *Coastlines*

At 20 nautical miles when the ground rises to 60 m.

At 7 nautical miles when the ground rises to 6 m.

.2 *Surface objects*

At 7 nautical miles a ship of 5,000 tons gross tonnage, whatever her aspect.

At 3 nautical miles a small vessel of 10 m in length.

At 2 nautical miles an object such as a navigational buoy having an effective echoing area of approximately 10 m^2,

* Annex of Assembly resolution A.477(XII)

3.2 Minimum range

The surface objects specified in paragraph 3.1.2 should be clearly displayed from a minimum range of 50 m up to a range of 1 nautical mile, without changing the setting of controls other than the range selector.

3.3 Display

3.3.1 The equipment should without external magnification provide a relative plan display in the head-up unstabilized mode with an effective diameter of not less than:

.1 180 mm* on ships of 500 tons gross tonnage and more but less than 1,600 tons gross tonnage;

.2 250 mm* on ships of 1,600 tons gross tonnage and more but less than 10,000 tons gross tonnage;

.3 340 mm* in the case of one display and 250 mm in the case of the other on ships of 10,000 tons gross tonnage and upwards.

3.3.2 The equipment should provide one of the two following sets of range scales of display:

.1 1.5, 3, 6, 12 and 24 nautical miles and one range scale of not less than 0.5, and not greater than 0.8 nautical miles; or

.2 1, 2, 4, 8, 16 and 32 nautical miles.

3.3.3 Additional range scales may be provided.

3.3.4 The range scale displayed and the distance between range rings should be clearly indicated at all times.

3.4 Range measurement

3.4.1 Fixed electronic range rings should be provided for range measurements as follows:

.1 where range scales are provided in accordance with subparagraph 3.3.2.1, on the range scale of between 0.5 and 0.8 nautical miles at least two range rings should be provided and on each of the other range scales six range rings should be provided, or

.2 where range scales are provided in accordance with subparagraph 3.3.2.2, four range rings should be provided on each of the range scales.

3.4.2 A variable electronic range marker should be provided with a numeric readout of range.

* Display diameters of 180, 250 and 340 mm correspond respectively to 9, 12 and 16-inch cathode ray tubes.

3.4.3 The fixed range rings and the variable range marker should enable the range of an object to be measured with an error not exceeding 1.5% of the maximum range of the scale in use, or 70 m, whichever is the greater.

3.4.4 It should be possible to vary the brilliance of the fixed range rings and the variable range marker and to remove them completely from the display.

3.5 Heading indicator

3.5.1 The heading of the ship should be indicated by a line on the display with a maximum error not greater than $\pm$ 1°. The thickness of the displayed heading line should not be greater than 0.5°.

3.5.2 Provision should be made to switch off the heading indicator by a device, which cannot be left in the " heading marker off" position.

3.6 Bearing measurement

3.6.1 Provision should be made to obtain quickly the bearing of any object whose echo appears on the display.

3.6.2 The means provided for obtaining bearings should enable the bearing of a target whose echo appears at the edge of the display to be measured with an accuracy of $\pm$ 1° or better.

3.7 Discrimination

3.7.1 The equipment should be capable of displaying as separate indications on a range scale of 2 nautical miles or less, two small similar targets at a range of between 50% and 100% of the range scale in use, and on the same azimuth, separated by not more than 50 m in range.

3.7.2 The equipment should be capable of displaying, as separate indications, two small similar targets both situated at the same range between 50% and 100% of the 1.5 or 2 nautical mile range scales, and separated by not more than 2.5° in azimuth.

3.8 Roll or pitch

The performance of the equipment should be such that when the ship is rolling or pitching up to $\pm$10° the range performance requirements of paragraphs 3.1 and 3.2 continue to be met.

3.9 Scan

The scan should be clockwise, continuous and automatic through 360° of azimuth. The scan rate should be not less than 12 r.p.m. The equipment should operate satisfactorily in relative wind speeds of up to 100 knots.

3.10 Azimuth stabilization

3.10.1 Means should be provided to enable the display to be stabilized in azimuth by a transmitting compass. The equipment should be provided with a compass input to enable it to be stabilized in azimuth. The accuracy of alignment with the compass transmission should be within 0.5° with a compass rotation rate of 2 r.p.m.

3.10.2 The equipment should operate satisfactorily in the unstabilized mode when the compass control is inoperative.

3.11 Performance check

Means should be available, while the equipment is used operationally, to determine readily a significant drop in performance relative to a calibration standard established at the time of installation, and to check that the equipment is correctly tuned in the absence of targets.

3.12 Anti-clutter devices

Suitable means should be provided for the suppression of unwanted echoes from sea clutter, rain and other forms of precipitation, clouds and sandstorms. It should be possible to adjust manually and continuously the anti-clutter controls. Anti-clutter controls should be inoperative in the fully anti-clockwlse positions. In addition, automatic anti-clutter controls may be provided; however, they must be capable of being switched off.

3.13 Operation

3.13.1 The equipment should be capable of being switched on and operated from the display position.

3.13.2 Operational controls should be accessible and easy to identify and use. Where symbols are used they should comply with the recommendations of the Organization on symbols for controls on marine navigational radar equipment.

3.13.3 After switching on from cold the equipment should become fully operational within 4 min.

3.13.4 A standby condition should be provided from which the equipment can be brought to an operational condition within 15 s.

3.14 Interference

After installation and adjustment on board, the bearing accuracy as prescribed in this Recommendation should be maintained without further adjustment irrespective of the movement of the ship in the earth's magnetic field.

3.15 Sea or ground stabilization (true motion display)

3.15.1 Where sea or ground stabilization is provided the accuracy and discrimination of the display should be at least equivalent to that required by this Recommendation.

3.15.2 The motion of the trace origin should not, except under manual override conditions, continue to a point beyond 75% of the radius of the display. Automatic resetting may be provided.

3.16 Antenna system

The antenna system should be installed in such a manner that the design efficiency of the radar system is not substantially impaired.

3.17 Operation with radar beacons

3.17.1 All radars operating in the 3 cm band should be capable of operating in a horizontally polarized mode.

3.17.2 It should be possible to switch off those signal processing facilities which might prevent a radar beacon from being shown on the radar display.

4 MULTIPLE RADAR INSTALLATIONS

4.1 Where two radars are required to be carried they should be so installed that each radar can be operated individually and both can be operated simultaneously without being dependent upon one another. When an emergency source of electrical power is provided in accordance with the appropriate requirements of chapter II-1 of the 1974 SOLAS Convention, both radars should be capable of being operated from this source.

4.2 Where two radars are fitted, interswitching facilities may be provided to improve the flexibility and availability of the overall radar installation. They should be so installed that failure of either radar would not cause the supply of electrical energy to the other radar to be interrupted or adversely affected.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR RADAR EQUIPMENT*

Valid for equipment installed on or after 1 January 1999

1 INTRODUCTION

In addition to the general requirements contained in resolution A.694(17) all radar installations should comply with the following minimum requirements.

2 GENERAL

The radar equipment should provide an indication, in relation to the ship of the position of other surface craft and obstructions and of buoys, shorelines and navigational marks in a manner which will assist in navigation and in avoiding collision.

3 RADAR

3.1 Range performance

The operational requirement under normal propagation conditions, when the radar antenna is mounted at a height of 15 m above sea level, is that the equipment should in the absence of clutter give a clear indication of:

.1 **Coastlines**

At 20 nautical miles when the ground rises to 60 m.

At 7 nautical miles when the ground rises to 6 m.

.2 **Surface objects**

At 7 nautical miles a ship of 5,000 gross tonnage, whatever her aspect.

At 3 nautical miles a small vessel of 10 m in length.

At 2 nautical miles an object such as a navigational buoy having an effective echoing area of approximately 10 m^2.

3.2 Minimum range

The surface objects specified in 3.1.2 should be clearly displayed from a minimum horizontal range of 50 m from the antenna position up to a range of 1 nautical mile, without changing the setting of controls other than the range selector.

* Annex 4 of MSC resolution MSC.64(67)

3.3 **Display**

3.3.1 The equipment should provide, without external magnification, a daylight display with a minimum effective diameter within the bearing scale of not less than:

.1 180 mm on ships of 150 gross tonnage and more but less than 1,000 gross tonnage;

.2 250 mm on ships of 1,000 gross tonnage and more but less than 10,000 gross tonnage; and

.3 340 mm on ships of 10,000 gross tonnage and upwards.

3.3.2 The equipment should provide the following set of range scales of display: 0.25, 0.5, 0.75, 1.5, 3, 6, 12 and 24 nautical miles.

3.3.3 Additional larger and smaller range scales may be provided.

3.3.4 The range scale displayed and the distance between range rings should be clearly indicated at all times.

3.3.5 Within the effective display radar video area, the display should only contain information which pertains to the use of the radar display for navigation or collision avoidance and which has to be displayed there because of its association with a target (e.g. target identifiers, vectors) or because of some other direct relationship with the radar display.

3.3.6 The origin of the range scale (radar video) should start at own ship, be linear and should not be delayed.

3.3.7 Multi-colour displays are permitted but the following requirements should be met:

.1 target echoes should be displayed by means of the same basic colours and the echo strength should not be displayed in different colours; and

.2 additional information may be shown in different colours.

3.3.8 The radar picture and information should be readable under all ambient light conditions. If a light shield is necessary to facilitate operation of the display in high ambient light levels, then means should be provided for its ready attachment and removal.

3.3.9 Selected parts of the System Electronic Navigation Chart (SENC) information may be displayed in such a way that the radar information is not masked, obscured or degraded. If SENC information is made available for a radar display it should at least include coastlines, own ship's safety contour, dangers to navigation and fixed and floating aids to navigation. The mariner should be able to select those parts of the SENC, which can be made available and the mariner requires to be displayed.

3.3.10 For the superimposition of selected parts of the SENC:

.1 Reference management
Reference management is required to ensure that the information displayed is correlated and in the same reference and co-ordinate system;

.2 Display Area
the whole effective display area should contain the available radar and SENC information;

.3 Matching and Adjustment
in case of any deviations between the chart image and the radar image through detectable causes, manual adjustment should be possible. Any manual adjustment should be clearly indicated as long as it is activated. Resetting should be possible in a simple manner;

.4 Priority in the Display
the display of radar information should have priority;

.5 Stability
The equipment should be capable of appropriately stabilizing the radar image, ARPA vectors and SENC information. The operating mode should be clearly indicated; and

.6 Independence of Radar/ARPA and SENC

.6.1 the SENC information should not have an adverse effect on the radar picture;

.6.2 Radar/ARPA information and SENC information should be clearly recognizable as such; and

.6.3 in the case of a malfunction of one component, the function of the other component should not be affected.

3.3.11 The frequency band in use should be indicated to the operator.

3.4 **Range measurement**

3.4.1 Electronic fixed range rings should be provided for range measurements as follows:

.1 on the range scale 0.25, 0.5, 0.75 nautical miles at least two and not more than six range rings should be provided, on each of the other mandatory range scales six range rings should be provided; and

.2 where off-centred facilities have been provided, additional range rings should be provided at the same range intervals.

3.4.2 An electronic variable range marker in the form of a ring should be provided with a numeric readout of range. This readout should not display any other data. For ranges of less than 1 nautical mile, there should be only one zero before the decimal point. Additional variable range markers may be provided.

3.4.3 The fixed range rings and the variable range markers should enable the range of an object to be measured with an error not exceeding 1% of the maximum range of the scale in use, or 30 m, whichever is the greater.

3.4.4 The accuracy should be maintained when the display is off-centred.

3.4.5 The thickness of the fixed range rings should not be greater than the maximum permissible thickness of the heading line.

3.4.6 On all range scales, it should be possible to set the variable range marker with the required precision within 5 s in all cases. A range that is set by the user should not change automatically when the range scale is changed.

3.5 **Heading indication**

3.5.1 The heading of the ship should be indicated by a continuous line on the display with a maximum error of not greater than ± 1°. The thickness of the displayed heading line should not be greater than 0.5° measured at maximum range at the edge of the radar display. The heading line should extend from the trace origin to the edge of the display.

3.5.2 Provision should be made to switch off the heading indicator by a device which cannot be left in the "heading line off" position.

3.5.3 A heading marker should be displayed on the bearing scale.

3.6 **Bearing measurement**

3.6.1 An Electronic Bearing Line, (EBL), should be provided with a numeric readout of bearing to obtain within 5 s the bearing of any object whose echo appears on the display.

3.6.2 The EBL should enable the bearing of a target whose echo appears at the edge of the display to be measured with a maximum error of not greater than $\pm$ 1°.

3.6.3 The EBL should be displayed on the screen in such a way that it is clearly distinguishable from the heading indicator. It should not be thicker than the heading indicator.

3.6.4 It should be possible to vary the brilliance of the EBL. This variation may be separate or combined with the intensity of other markers. It should be possible to remove the EBL completely from the screen.

3.6.5 The rotation of the EBL should be possible in both directions continuously or in steps of not more than 0.2°.

3.6.6 The numeric readout of the bearing of the EBL should be displayed with at least 4 digits, including one after the decimal point. The EBL readout should not be used to display any other data. There should be a positive identification of whether the bearing indicated is a relative bearing or a true bearing.

3.6.7 A bearing scale around the edge of the display should be provided. Linear or non-linear bearing scales may be provided.

3.6.8 The bearing scale should have division marks for at least each 5°, with the 5° and 10° divisions clearly distinguishable from each other. Numbers should clearly identify at least each 30° division.

3.6.9 It should be possible to measure the bearing relative to the heading line and relative north.

3.6.10 A minimum of two independent lines of parallel index lines should be provided.

3.6.11 It should be possible to move the position of the EBL origin away from the own ship to any desired point on the effective display area. By a fast simple operation it should be possible to move the EBL origin back to own ship's position on the screen. On the EBL, it should be possible to display a variable range marker.

3.7 **Discrimination**

3.7.1 **Range**

The equipment should be capable of displaying as separate indications on a range scale of 1.5 nautical miles, two small similar targets at a range of between 50% and 100% of the range scale, and on the same bearing, separated by not more than 40 m in range.

3.7.2 **Bearing**

The equipment should be capable of displaying as separate indications two small similar targets both situated at the same range between 50% and 100% of the 1.5 nautical mile range scale, and separated by not more than 2.5° in bearing.

3.8 **Roll or pitch**

The performance of the equipment should be such that when the ship is rolling or pitching up to $\pm$ 10° the range performance requirements of 3.1 and 3.2 continue to be met.

3.9 **Antenna Scan**

The scan should be clockwise, continuous and automatic through 360° of azimuth. The antenna rotation rate should be not less than 20 revolutions per minute. The equipment should start and operate satisfactorily in relative wind speeds of up to 100 knots. Alternative methods of scanning are permitted provided that the performance is not inferior.

3.10 **Azimuth stabilization**

3.10.1 Means should be provided to enable the display to be stabilized in azimuth by a gyro-compass, or its equivalent in performance. The accuracy of alignment with the compass transmission should be within 0.5° with a compass rotation rate of 2 revolutions per minute.

3.10.2 The equipment should operate satisfactorily in the head-up unstabilized mode when the azimuth stabilization is inoperative.

3.10.3 Change over from one display mode to the other should be possible within 5 s and achieve the required bearing accuracy.

3.11 **Performance monitoring**

Means should be available, while the equipment is used operationally, to determine readily a significant drop in system performance relative to a calibration standard established at the time of installation. Means should be provided to check that the equipment is correctly tuned in the absence of targets.

3.12 **Anti-clutter devices**

3.12.1 Suitable means should be provided for the suppression of unwanted echoes from sea clutter, rain and other forms of precipitation, clouds, sandstorms and from other radars. It should be possible to adjust manually and continuously the anti-clutter controls. In addition, automatic anti-clutter controls may be provided; however, they should be capable of being switched off.

3.12.2 The operational requirement, when the radar antenna is mounted at a height of 15 m above sea level, is that the equipment should, even in the presence of sea clutter, give a clear indication of a standard reflector up to 3.5 nautical miles.

3.13 **Operation**

3.13.1 **Availability**

After switching on from cold the equipment should become fully operational within 4 min.

A stand-by condition should be provided from which the equipment can be brought to an operational condition within 15 s.

3.13.2 **Controls**

Operational controls should be accessible and easy to identify and use. Controls should be identified and easy to operate.[1]

The equipment should be capable of being switched on and off and operated from the master display position.

[1]IEC 936 and IEC 945 Publications.

It should be possible to vary the brilliance of the fixed range rings and the variable range markers and electronic bearing lines and to remove them independently and completely from the display.

For radars with additional synthetic information (e.g. target identifiers, vectors, navigational information), means should be provided capable of removing this additional information from the screen.

3.14 **Operation with radar beacons and SARTS**

3.14.1 Radar should be able to detect and display signals from radar beacons and 9 GHz radars should also be able to detect and display signals from Search and Rescue Transponders (SARTs).

3.14.2 All radars operating in the 9 GHz band should be capable of operating in a horizontally polarized mode. If other polarization modes are available there should be a positive indication of their use on the display.

3.14.3 It should be possible to switch off those signal processing facilities which might prevent a radar beacon or SART from being shown on the radar display.

3.15 **Display modes**

3.15.1 The equipment should be capable of operating in relative and true motion.

3.15.2 The radar origin should be capable of being off-set to at least 50% and not more than 75% of the radius of the display.

3.15.3 The radar should be capable of sea and ground stabilisation. With sea or ground stabilisation the accuracy and discrimination of the display should be at least equivalent to that required by this Performance Standard.

3.15.4 Speed and Distance Measuring Equipment (SDME) providing the ship’s speed through the water to the radar should be capable of providing the speed in the fore and aft direction.

3.15.5 The ground stabilized input should be two-dimensional. It may be provided from the SDME, from an electronic position-fixing system or from radar tracked stationary targets. The speed accuracy should be in accordance with the requirements of resolution A.824(19).

3.15.6 The type of input and stabilisation in use should be displayed.

3.15.7 It should also be possible to input the ship's speed manually from 0 (zero) knots to 30 knots in steps of not more than 0.2 knots.

3.15.8 Provision should be made for manual input of set and drift.

3.16 **Interference from external magnetic fields**

After installation and adjustment on board, the bearing accuracy as prescribed in this Performance Standard should be maintained without further adjustment irrespective of the movement of the ship in the earth's magnetic field.

3.17 **Radar installation**

The radar installation, including the antenna, should be in such a manner that the performance of the radar system is not substantially impaired. Guidance on installation should be given in manufacturer documentation.

3.18 **Failure Warnings and Status indications**

If there is any detectable reason why the information presented to the operator is invalid, adequate and clear warning should be given to the operator.

4 MULTIPLE RADAR INSTALLATIONS

4.1 Where two radars are required to be carried they should be so installed that each radar can be operated individually and both can be operated simultaneously without being dependant upon one another. When an emergency source of electrical power is provided in accordance with the appropriate requirements of chapter II-1 of the 1974 SOLAS Convention, both radars should be capable of being operated from this source.

4.2 Where two radars are fitted, interswitching facilities may be provided to improve the flexibility and availability of the overall radar installation. They should be so installed that failure of either radar would not cause the other radar to be adversely affected.

5 INTERFACE

5.1 The radar system should be capable of receiving information from equipment such as gyro-compass, speed and distance measurement equipment (SDME) and electronic position-fixing systems (EPFS) in accordance with international standards.[1] The source of received information should be capable of being displayed.

5.2 The radar should provide an indication when any input from an external sensor is absent. The radar should also repeat any alarms or status messages concerning the quality of the input data from it's external sensors.

5.3 If any radar outputs are provided they should be in accordance with international standards.[1]

6 NAVIGATIONAL INFORMATION

The radar display should be capable of presenting in graphical form, positions, navigational lines and maps, in addition to the radar information. It should be possible to adjust these points, lines and maps relative to a geographical reference. The source of the graphical information and the method of geographical referencing should be clearly indicated.

[1] IEC 1162 Publication.

7 PLOTTING

Plotting facilities should be provided with the radar as follows:

7.1 Ships which are fitted with an electronic plotting aid should be fitted with an "electronic plotting aid" for manual direct plotting as defined in Appendix 2.

7.2 Ships which are fitted with an Auto Tracking Aid should be fitted with an "Auto Tracking Aid" as defined in Appendix 1.

7.3 Ships which are fitted with an Automatic Radar Plotting Aid should be fitted with ARPA with a minimum effective diameter of 250 mm as defined in resolution A.823(19). The second radar should be fitted with at least an "Auto Tracking Aid".

7.4 Ships of 10,000 gross tonnage and more should be fitted with ARPAs with a minimum effective diameter of 340 mm as defined in resolution A.823(19).

7.5 It should be possible to display the trails of radar echoes of targets in the form of synthetic afterglow. The trails may be either relative or true. The true trails may be sea or ground stabilised. The trails should be distinguishable from the targets.

8 ERGONOMICS

8.1 The following functions should be directly accessible and immediately effected:

- On-/off-switch
- Monitor brilliance
- Tuning (if manual)
- Range selection
- Anticlutter rain
- Electronic bearing line
- Dimmer for panel illumination
- Gain
- Presentation made
- Anticlutter sea
- Variable range marker
- Marker (cursor)

8.2 The following functions should be continuously variable or in small, quasi-analogue steps:

- Monitor brilliance
- Tuning (if manual)
- Anticlutter rain
- Electronic bearing line
- Gain
- Anticlutter sea
- Variable range marker
- Marker (cursor)

8.3 The settings of the following functions should be readable in all light conditions:

- Dimmer for panel illumination
- Gain
- Anticlutter sea
- Monitor brilliance
- Tuning (if manual)
- Anticlutter rain

8.4 For the following functions additional automatic adjustment may be provided. The use of the automatic mode be indicated to the operator and be capable of being switched off:

- Monitor brilliance
- Gain
- Anticlutter rain
- Anticlutter sea

8.5 If discrete controls are available for the EBL and VRM they should be situated on the left and right hand side respectively.

APPENDIX 1

PERFORMANCE STANDARDS FOR "AUTO TRACKING"

1 INTRODUCTION

"Auto Tracking" should, in order to improve the standard of collision avoidance at sea:

.1 reduce the workload of observers by enabling them to obtain information about automatically plotted targets so that they can perform as well with several separate targets as they can by manually plotting a single target; and

.2 provide continuous, accurate and rapid situation evaluation.

2 DEFINITIONS

Definitions of terms used in these performance standards are given in annex 1 to this appendix.

3 PERFORMANCE STANDARDS

3.1 Detection

3.1.1 Where a separate facility is provided for detection of targets, other than by the radar observer, it should have a performance not inferior to that which could be obtained by the use of the radar display.

3.2 Acquisition

3.2.1 There should be a facility to provide for manual acquisition and cancellation for relative speeds up to 100 knots.

3.2.2 Manual acquisition should have a performance not inferior to that which could be obtained by the user of the radar display.

3.3 Tracking

3.3.1 The "auto tracking" should be able to automatically track, process, simultaneously display and continuously update the information on at least 10 targets.

3.3.2 The "auto tracking" should continue to track an acquired target which is clearly distinguishable on the display for 5 out of 10 consecutive scans, provided the target is not subject to target swop.

3.3.3 The possibility of tracking errors, including target swop, should be minimised by "auto tracking" design. A qualitative description of the effects of error sources on the automatic tracking and corresponding errors should be provided to the user, including the effects of low signal-to-noise and low signal-to-clutter ratios caused by sea returns, rain, snow, low clouds and non-synchronous emissions.

3.4 **Display**

3.4.1 The display may be a separate or integral part of the ship's radar. However the "auto tracking" display should include all the data required to be provided by a radar display in accordance with the performance standards for navigational radar equipment.

3.4.2 The design should be such that any malfunction of "auto tracking" parts producing data additional to information to be produced by the radar as required by the performance standards for navigational equipment should not affect the integrity of the basic radar presentation.

3.4.3 The "auto tracking" facilities should be available on at least the 3,6 and 12 nautical mile range scales, and there could be a positive indication of the range scale in use.

3.4.4 "Auto tracking" facilities may also be provided on other range scales.

3.4.5 The "auto tracking" should be capable of operating with a relative motion display with "north-up" and "course-up" azimuth stabilization. In addition, the "auto tracking" may also provide for a true motion display. If true motion is provided, the operator should be able to select for his display either true or relative motion. There should be a positive indication of the display mode and orientation in use.

3.4.6 The course and speed information generated by the "auto tracking" for acquired targets should be displayed in a vector or graphic form which clearly indicates the target's predicted motion with relevant symbols[1]. In this regard:

.1 "auto tracking" presenting predicted information in vector form only should have the option of both true and relative vectors. There should be an indication of the vector mode selected, and if "true" is selected there should be a display of whether it is stabilized with reference to sea or ground;

.2 an "auto tracking" which is capable of presenting target course and speed information in graphic form should also, on request, provide the target's true and/or relative vector;

.3 vectors displayed should be time adjustable;

.4 a positive indication of the time-scale of vector in use should be given; and

.5 if stationary targets are being used for ground referencing then this should be indicated with the relevant symbol[1]. In this mode, relative vectors including those of the targets used for ground referencing should be displayed when requested.

[1]IEC 872 Publication.

3.4.7 The "auto tracking" information should not obscure the visibility of radar targets. The display of "auto tracking" data should be under the control of the radar observer. It should be possible to cancel the display of unwanted "auto tracking" data within 3 s.

3.4.8 Means should be provided to adjust independently the brilliance of the "auto tracking" data and radar data, including complete extinction of the "auto tracking" data.

3.4.9 The method of presentation should ensure that the "auto tracking" data are clearly visible in general to more than one observer in the conditions of light normally experienced on the brige of a ship by day and by night. Screening may be provided to shade the display from sunlight but not to the extent that it will impair the observer's ability to maintain a proper look-out. Facilities to adjust the brightness should be provided.

3.4.10 Provisions should be made to obtain quickly the range and bearing of any object which appears on the "auto tracking" display.

3.4.11 The "auto tracking" should present in a period of not more than 1 min an indication of the target's motion trend and display within 3 min the target's predicted motion in accordance with paragraphs 3.4.6, 3.6, 3.7.2 and 3.7.3 of this Appendix.

3.4.12 After changing range scales on which the "auto tracking" facilities are available or resetting the display, full plotting information should be displayed within a period of time not exceeding one scan.

3.5 **Operational warnings**

3.5.1 The "auto tracking" should have the capability to warn the observer with a visual and audible signal of any distinguishable target which closes to a range or transits a zone chosen by the observer. The target causing the warning should be clearly indicated with the relevant symbols[3] on the display.

3.5.2 The "auto tracking" should have the capability to warn the observer with a visual and audible signal of any tracked target which is predicted to close within a minimum range and time chosen by the observer. The target causing the warning should be clearly indicated with the relevant symbols[3] on the display.

3.5.3 The "auto tracking" should clearly indicate if a tracked target is lost, other than out of range, and the target's last tracked position should be clearly indicated on the display.

3.5.4 It should be possible for the observer to activate or deactivate the audible warning capability.

3.6 **Data requirements**

3.6.1 The observer should be able to select any tracked target to obtain data. Targets selected should be marked with the relevant symbol on the radar display[3]. If data is required for more than one target at the same time each symbol shall be separately identified, for example with a number adjacent to the symbol.

3.6.2 The following data for each selected target should be clearly and unambiguously identified and displayed immediately and simultaneously in alpha-numeric form outside the radar area:

.1 present range of the target;

.2 present bearing of the target;

.3 predicted target range at the closest point of approach (CPA);

.4 predicted time to CPA (TCPA);

.5 calculated true course of the target; and

.6 calculated true speed of the target.

3.6.3 The display of 3.6.2, items 5 and 6 should include an identification of whether the data uses sea or ground reference.

3.6.4 When data for several targets is displayed, not less than two items should be displayed simultaneously for each target selected. If the items of data are displayed in pairs for each target the groupings should be: 3.6.2 items 1 with 2, 3 with 4; and, 5 with 6.

3.7 **Accuracy**

3.7.1 The "auto tracking" should provide accuracies not less than those given in paragraphs 3.7.2 and 3.7.3 for the four scenarios defined in annex 2 to this appendix. With the sensor errors specified in annex 3 to this appendix, the values given relate to the best possible manual plotting performance under environmental conditions of ± 10□ of roll.

3.7.2 The "auto tracking" should present within 1 min of steady state tracking the relative motion trend of a target with the following accuracy values (95% probability values).

Data / Scenario	Relative course (o)	Relative speed (knots)	CPA (nautical miles)
1	11	2.8	1.6
2	7	0.6	
3	14	2.2	1.8
4	15	1.5	2

Note 1: In steady state tracking both own and target ship follow straight line course at constant speed.

Note 2: Probability values are the same as confidence levels.

3.7.3 The "auto tracking" should present within three minutes of steady state tracking the motion of a target with the following accuracy values (95% probability values).

Data / Scenario	Relative course (°)	Relative speed (knots)	CPA (nautical miles)	TCPA (min)	True course (°)	True speed (knots)
1	3.0	0.8	0.5	1.0	7.4	1.2
2	2.3	0.3			2.8	0.8
3	4.4	0.9	0.7	1.0	3.3	1.0
4	4.6	0.8	0.7	1.0	2.6	1.2

3.7.4 When a tracked target, or own ship, has completed a manoeuvre, the system should present in a period of not more than one minute an indication of the target's motion trend and display within 3 min the target's predicted motion, in accordance with paragraphs 3.4.6, 3.6, 3.7.2 and 3.7.3 of this Appendix. In this context, a "manoeuvre of own ship shall be deemed to consist of an alteration of course $\pm$ 45 in 1 min.

3.7.5 The "auto tracking" should be designed in such a manner that under the most favourable conditions of own ship motion the error contribution from the "auto tracking" should remain insignificant compared to the errors associated with the input sensors, for the scenarios of annex 2 to this appendix.

3.8 **Connections with other equipment**

3.8.1 The "auto tracking" should not degrade the performance of any equipment providing sensor inputs. The connection of the "auto tracking" to any other equipment should not degrade the performance of that equipment. This requirement should be met whether the 'auto tracking' is operating or not. Additionally the "auto tracking" should be designed to comply with this requirement under fault conditions as far as is practicable.

3.9 **Performance tests and warnings**

3.9.1 The "auto tracking" should provide suitable warnings of "auto tracking" malfunction to enable the observer to monitor the proper operation of the system. Additionally, test programmes should be available so that the overall performance of "auto tracking" can be assessed periodically against a known solution. When a test programme is being executed the relevant test symbols[3] should be displayed.

3.10 **Sea and ground stabilisation**

3.10.1 Log and speed indicators providing inputs to "auto tracking" equipment should be capable of providing the ship's speed through the water in the fore and aft direction.

3.10.2 If a ground stabilised input is also available from the log, from an electronic position-fixing system or from tracked stationary targets then the type of input in use should be displayed.

3.11 **Equipment connected to "Auto Tracking"**

3.11.1 Speed and course measuring equipment should be connected to the "auto tracking".

3.11.2 The speed input should provide speed through the water and may, in addition, provide speed over ground.

3.11.3 The type of measuring equipment in use should be indicated on the display.

ANNEX 1 to APPENDIX "Auto Tracking"

DEFINITIONS OF TERMS TO BE USED IN CONNECTION WITH "AUTO TRACKING" AND RADAR PERFORMANCE STANDARDS

Target:	Any object fixed or moving whose position and motion is determined by measurements of range and bearing on radar.
Relative Course:	The direction of motion of a target relative to own ship's position expressed as an angular displacement from north. It is deduced from a number of measurements of target range and bearing on own ship's radar.
Relative Speed:	The speed of a target relative to own ship's position. It is deduced from a number of measurements of target range and bearing on own ship's radar.
Relative Motion:	The combination of relative course and relative speed.
True Course:	The true direction of motion of a target expressed as an angular displacement from north. It is obtained by a vector combination of target relative motion and own ship's true motion.*
True Speed:	The speed of a target obtained by a vector combination of target relative motion and own ship's true motion.*
True Motion:	The combination of true course and true speed.
True Bearing:	The direction of a target from own ship or from another target expressed as an angular displacement from north.
Relative Bearing:	The direction of a target from own ship expressed as an angular displacement from own ship's heading.
True Motion Display:	A display across which own ship and each target moves with its own true motion.
Relative Motion Display:	A display on which the position of own ship remains fixed and all targets move relative to own ship.
Azimuth Stabilised Display:	A display on which the azimuth orientation relative to a nominated true bearing is fixed.
North-up Display:	An azimuth stabilised display in which a line connecting the centre with the top of the display is north true bearing.
Course-up Display:	An azimuth stabilised display in which a line connecting the centre with the top or the display is own ship's intended course.

* For the purposes of these definitions there is no need to distinguish between sea and ground stabilisation.

Heading:	The direction in which the bows of a ship are pointing expressed as an angular displacement from north.
Target's Predicted Motion:	A prediction of future target motion based on linear extrapolation from its motion as determined by past measurements of its range and bearing on present the radar.
Relative Vector:	The predicted movement of a target relative to own ship.
True Vector:	The predicted True Motion of a target as a result of own ship's direction and speed input. The True Vector may be either displayed with reference to the sea or to the ground.
Acquisition:	The process of selecting a target or targets in order to initiate their tracking.
Tracking:	The computer process of observing the sequential changes in the position of a target in order to establish its motion.
Target Swop:	A situation in which the incoming radar data for a tracked target becomes incorrectly associated with another tracked target or a radar echo.
Echo Reference:	A facility for indicating that a particular fixed Navigational Mark which is being tracked is to be used as a Ground Stabilised reference.
CPA/TCPA:	Closest Point of Approach and Time to Closest Point of Approach limit as defined by the observer to give warning when a tracked target or targets will close to within these limits from own ship.
Bad Echo:	The name associated with a tracked target which appears to have been temporarily lost or which has a poorly defined radar aspect, in so much that, the target does not have tracking ability.
Lost Target:	The name associated with a target that is no longer being tracked having become lost or obscured.
Sea Stabilization:	A mode of display whereby own ship and all targets are referenced to the sea, using gyro heading and single axis Log Water speed inputs. This display is ideal for both Collision Avoidance and Navigational purposes.
Ground Stabilization:	A mode of display whereby own ship and all targets are referenced to the Ground using Ground Track or Set and Drift inputs. This display is ideal for Navigational purposes. However it should be used with extreme caution when assessing close quarter situations with other targets.

Note: Where reference is made to target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA), these measurements are made with respect to the Radar Antenna.

ANNEX 2 to APPENDIX 1 "Auto Tracking"

OPERATIONAL SCENARIOS

For each of the following scenarios predictions are made at the target position defined after previously tracking for the appropriate time of one or three min:

Scenario 1

Own ship course	000°
Own ship speed	10 knots
Target range	8 nautical miles
Bearing of target	000°
Relative course of target	180°
Relative speed of target	20 knots

Scenario 2

Own ship course	000°
Own ship speed	10 knots
Target range	1 nautical miles
Bearing of target	000°
Relative course of target	090°
Relative speed of target	10 knots

Scenario 3

Own ship course	000°
Own ship speed	5 knots
Target range	8 nautical miles
Bearing of target	045°
Relative course of target	225°
Relative speed of target	20 knots

Scenario 4

Own ship course	000°
Own ship speed	25 knots
Target range	8 nautical miles
Bearing of target	045°
Relative course of target	225°
Relative speed of target	20 knots

ANNEX 3 to APPENDIX 1 "Auto Tracking"

SENSOR ERRORS

The accuracy figures quoted in paragraph 3.7 of the Appendix are based upon the following sensor errors and are appropriate to equipment complying with the performance standards for shipborne navigational equipment.

Note: **δ** means "standard deviation".

Radar

Target glint (scintillation) (for 200 m length target)

Along length of target δ = 30 m (normal distribution)

Across beam of target δ = 1 m (normal distribution)

Roll-pitch bearing. The bearing error will peak in each of the four quadrants around own ship for targets on relative bearings of 045°, 135°, 225° and 315° and will be zero at relative bearings of 000°, 090°, 180° and 270°.

This error has a sinusoidal variation at twice the roll frequency.

For a 10° roll the mean error is 0.22° with a 0.22° peak sine wave superimposed.

Beam shape - assumed normal distribution giving bearing error with δ = 0.05°

Pulse shape - assumed normal distribution giving range error with δ = 20 m

Antenna backlash - assumed rectangular distribution giving bearing error $\pm$ 0.05° maximum

Quantization

Bearing - rectangular distribution $\pm$ 0.1° maximum
Range - rectangular distribution $\pm$ 0.01 nautical miles maximum

Bearing encoded assumed to be running from a remote synchro giving bearing errors with a normal distribution δ = 0.03°.

Gyro-compass

Calibration error 0.5°
Normal distribution about this with δ = 0.12°

Log

Calibration error 0.5°
Normal distribution about this, 3δ = 0.2 knots.

APPENDIX 2

ELECTRONIC PLOTTING AIDS

1 Introduction

The electronic plotting aid for manual direct plotting is intended for small ships fitted with either a gyro compass or transmitting marine electromagnetic compass.[1] The plotting aid is not suitable for ships classed as high speed craft.

2 Performance standards

2.1 The electronic plotting aid should provide a means to plot a minimum of 10 targets on a radar display.

2.2 It should be possible to plot targets on the 3, 6 and 12 nautical mile range scales. The facility may be provided on additional range scales. Plots should be maintained when switching between range scales.

2.3 It should be possible to plot targets with a relative speed up to 75 knots.

2.4 It should be possible for the operator to adjust the CPA/TCPA limits and the vector time.

2.5 Plot positions should be identified by an approved symbol and an associated plot number. It should be possible to switch off the plot number.

2.6 The minimum lapsed time between any two plots should be greater than 30 s.

2.7 After the second plot, a vector should be displayed on the target. It should be possible to select a true or relative vector. There should be a positive indication of vector mode.

2.8 The vector origin should move across the screen at a rate and direction defined by the calculated true course and speed.

2.9 It should be possible to correct the position of a plot.

2.10 It should be possible, on demand, to display the following data on a selected target:

.1 plot number: time since last plot (min)

.2 present range of the target

.3 present bearing of the target

.4 predicted target range at the closest point of approach (CPA)

.5 predicted time to CPA (TCPA)

[1] ISO 11606 Publication.

.6 calculated true course of target

.7 calculated true speed of target

The selected plot should be clearly identified with an approved symbol and the plot data should be displayed outside of the screen radar area.

2.11 There should be an indication of any plot that is not updated for 10 min. The plot should be dropped if the time between consecutive plots exceeds 15 min.

PERFORMANCE STANDARDS FOR AUTOMATIC RADAR PLOTTING AIDS (ARPAS)*

Valid for equipment installed before 1 January 1997

1 INTRODUCTION

1.1 Automatic radar plotting aids (ARPA) should, in order to improve the standard of collision avoidance at sea:

.1 reduce the workload of observers by enabling them to automatically obtain information so that they can perform as well with multiple targets as they can by manually plotting a single target; and

.2 provide continuous, accurate and rapid situation evaluation.

1.2 In addition to the general requirements for electronic navigational aids (resolution A.281 (VIII)), the ARPA should comply with the following minimum performance standards.

2 DEFINITIONS

Definitions of terms used in these performance standards are given in appendix 1.

3 PERFORMANCE STANDARDS

3.1 Detection

Where a separate facility is provided for detection of targets, other than by the radar observer, it should have a performance not inferior to that which could be obtained by the use of the radar display.

3.2 Acquisition

3.2.1 Target acquisition may be manual or automatic. However, there should always be a facility to provide for manual acquisition and cancellation: ARPA with automatic acquisition should have a facility to suppress acquisition in certain areas. On any range scale where acquisition is suppressed over a certain area, the area of acquisition should be indicated on the display.

3.2.2 Automatic or manual acquisition should have a performance not inferior to that which could be obtained by the user of the radar display.

3.3 Tracking

3.3.1 The ARPA should be able to automatically track, process, simultaneously display and continuously update the information on at least:

.1 20 targets, if automatic acquisition is provided, whether automatically or manually acquired; and

* Annex of Assembly resolution A.422(XI)

.2 10 targets, if only manual acquisition is provided.

3.3.2 If automatic acquisition is provided, description of the criteria of selection of targets for tracking should be provided to the user. If the ARPA does not track all targets visible on the display, targets which are being tracked should be clearly indicated on the display. The reliability of tracking should not be less than that obtainable using manual recordings of successive target positions obtained from the radar display.

3.3.3 Provided the target is not subject to target swop, the ARPA should continue to track an acquired target which is clearly distinguishable on the display for 5 out of 10 consecutive scans.

3.3.4 The possibility of tracking errors, including target swop, should be minimized by ARPA design. A qualitative description of the effects of error sources on the automatic tracking and corresponding errors should be provided to the user, including the effects of low signal-to-noise and low signal-to-clutter ratios caused by sea returns, rain, snow, low clouds and non-synchronous emissions.

3.3.5 ARPA should be able to display on request at least four equally time-spaced past positions of any targets being tracked over a period of at least 8 min.

3.4 Display

3.4.1 The display may be a separate or integral part of the ship's radar. However, the ARPA display should include all the data required to be provided by a radar display in accordance with the performance standards for navigational radar equipment.

3.4.2 The design should be such that any malfunction of ARPA parts producing data additional to information to be produced by the radar as required by the performance standards for navigational equipment should not affect the integrity of the basic radar presentation.

3.4.3 The display on which ARPA information is presented should have an effective diameter of at least 340 mm.

3.4.4 The ARPA facilities should be available on at least the following range scales:

.1 12 or 16 nautical miles; and

.2 3 or 4 nautical miles.

3.4.5 There should be a positive indication of the range scale in use.

3.4.6 The ARPA should be capable of operating with a relative motion display with "north-up" and either "head-up" or "course-up" azimuth stabilization. In addition, the ARPA may also provide for a true motion display. If true motion is provided, the operator should be able to select for his display either true or relative motion. There should be a positive indication of the display mode and orientation in use.

3.4.7 The course and speed information generated by the ARPA for acquired targets should be displayed in a vector or graphic form which clearly indicates the target's predicted motion. In this regard:

.1 ARPA presenting predicted information in vector form only should have the option of both true and relative vectors;

.2 an ARPA which is capable of presenting target course and speed information in graphic form should also, on request, provide the target's true and/or relative vector;

.3 vectors displayed should either be time-adjustable or have a fixed time-scale; and

.4 a positive indication of the time-scale of the vector in use should be given.

3.4.8 The ARPA information should not obscure radar information in such a manner as to degrade the process of detecting targets. The display of ARPA data should be under the control of the radar observer. It should be possible to cancel the display of unwanted ARPA data.

3.4.9 Means should be provided to adjust independently the brilliance of the ARPA data and radar data, including complete elimination of the ARPA data.

3.4.10 The method of presentation should ensure that the ARPA data are clearly visible in general to more than one observer in the conditions of light normally experienced on the bridge of a ship by day and by night. Screening may be provided to shade the display from sunlight but not to the extent that it will impair the observer's ability to maintain a proper lookout. Facilities to adjust the brightness should be provided.

3.4.11 Provisions should be made to obtain quickly the range and bearing of any object which appears on the ARPA display.

3.4.12 When a target appears on the radar display and, in the case of automatic acquisition, enters within the acquisition area chosen by the observer or, in the case of manual acquisition, has been acquired by the observer, the ARPA should present in a period of not more than 1 min an indication of the target's motion trend and display within 3 min the target's predicted motion in accordance with paragraphs 3.4.7, 3.6, 3.8.2 and 3.8.3.

3.4.13 After changing range scales on which the ARPA facilities are available or resetting the display, full plotting information should be displayed within a period of time not exceeding four scans.

3.5 Operational warnings

3.5.1 The ARPA should have the capability to warn the observer with a visual and/or audible signal of any distinguishable target which closes to a range or transits a zone chosen by the observer. The target causing the warning should be clearly indicated on the display.

3.5.2 The ARPA should have the capability to warn the observer with a visual and/or audible signal of any tracked target which is predicted to close within a minimum range and time

chosen by the observer. The target causing the warning should be clearly indicated on the display.

3.5.3 The ARPA should clearly indicate if a tracked target is lost, other than out of range, and the target's last tracked position should be clearly indicated on the display.

3.5.4 It should be possible to activate or de-activate the operational warnings.

3.6 Data requirements

3.6.1 At the request of the observer the following information should be immediately available from the ARPA in alphanumeric form in regard to any tracked target:

.1 present range to the target;
.2 present bearing of the target;
.3 predicted target range at the closest point of approach (CPA);
.4 predicted time to CPA (TCPA); and
.5 calculated true course of target;
.6 calculated true speed of target.

3.7 Trial manoeuvre

3.7.1 The ARPA should be capable of simulating the effect on all tracked targets of an own ship manoeuvre without interrupting the updating of target information. The simulation should be initiated by the depression either of a spring-loaded switch, or of a function key, with a positive identification on the display.

3.8 Accuracy

3.8.1 The ARPA should provide accuracies not less than those given in paragraphs 3.8.2 and 3.8.3 for the four scenarios defined in appendix 2. With the sensor errors specified in appendix 3, the values given relate to the best possible manual plotting performance under environmental conditions of $\pm$ 10° of roll.

3.8.2 An ARPA should present within 1 min of steady state tracking the relative motion trend of a target with the following accuracy values (95% probability values).

Data / **Scenario**	**Relative course** (degrees)	**Relative speed** (knots)	**CPA** (nautical miles)
1	11	2.8	1.6
2	7	0.6	-
3	14	2.2	1.8
4	15	1.5	2.0

3.8.3 An ARPA should present within 3 min of steady state tracking the motion of a target with the following accuracy values (95% probability values).

Data / Scenario	**Relative course** (degrees)	**Relative Speed** (knots)	**CPA** (nautical miles)	**TCPA** (min)	**True Course** (degrees)	**True speed** (knots)
1	3.0	0.8	0.5	1.0	7.4	1.2
2	2.3	0.3	-	-	2.8	0.8
3	4.4	0.9	0.7	1.0	3.3	1.0
4	4.6	0.8	0.7	1.0	2.6	1.2

3.8.4 When a tracked target, or own ship, has completed a manoeuvre, the system should present in a period of not more than 1 min an indication of the target's motion trend, and display within 3 min the target's predicted motion, in accordance with paragraphs 3.4.7, 3.6, 3.8.2 and 3.8.3.

3.8.5 The ARPA should be designed in such a manner that under the most favourable conditions of own ship motion the error contribution from the ARPA should remain insignificant compared to the errors associated with the input sensors, for the scenarios of appendix 2.

3.9 Connections with other equipment

The ARPA should not degrade the performance of any equipment providing sensor inputs. The connection of the ARPA to any other equipment should not degrade the performance of that equipment.

3.10 Performance tests and warnings

The ARPA should provide suitable warnings of ARPA malfunction to enable the observer to monitor the proper operation of the system. Additionally, test programmes should be available so that the overall performance of ARPA can be assessed periodically against a known solution.

3.11 Equipment used with ARPA

Log and speed indicators providing inputs to ARPA equipment should be capable of providing the ship's speed through the water.

Appendix 1
DEFINITIONS OF TERMS TO BE USED ONLY IN CONNECTION WITH ARPA PERFORMANCE STANDARDS

Relative course — The direction of motion of a target related to own ship as deduced from a number of measurements of its range and bearing on the radar, expressed as an angular distance from north.

Relative speed — The speed of a target related to own ship, as deduced from a number of measurements of its range and bearing on the radar.

True course	The apparent heading of a target obtained by the vectorial combination of the target's relative motion and own ship's motion*, expressed as an angular distance from north.
True speed	The speed of a target obtained by the vectorial combination of its relative motion and own ship's motion.*
Bearing	The direction of one terrestrial point from another, expressed as an angular distance from north.
Relative motion display	The position of own ship on such a display remains fixed.
True motion display	The position of own ship on such a display moves in accordance with its own motion.
Azimuth stabilization	Own ship's compass information is fed to the display so that echoes of targets on the display will not be caused to smear by changes of own ship's heading.
- north up	The line connecting the centre with the top of the display is north.
- head up	The line connecting the centre with the top of the display is own ship's heading.
- course up	An intended course can be set to the line connecting the centre with the top of the display.
Heading	The direction in which the bows of a ship are pointing, expressed as an angular distance from north.
Target's predicted motion	The indication on the display of a linear extrapolation into the future of a target's motion, based on measurements of the target's range and bearing on the radar in the recent past.
Target's motion trend	An early indication of the target's predicted motion.
Radar plotting	The whole process of target detection, tracking, calculation of parameters and display of information.
Detection	The recognition of the presence of a target.
Acquisition	The selection of those targets requiring a tracking procedure and the initiation of their tracking.
Tracking	The process of observing the sequential changes in the position of a target, to establish its motion.

* For the purpose of these definitions there is no need to distinguish between sea and ground stabilization.

Display	The plan position presentation of ARPA data with radar data.
Manual	Relating to an activity which a radar observer performs, possibly with assistance from a machine.
Automatic	Relating to an activity which is performed wholly by a machine.

Appendix 2
OPERATIONAL SCENARIOS

For each of the following scenarios predictions are made at the target position defined after previously tracking for the appropriate time of l or 3 min:

Scenario 1

Own ship course	000°
Own ship speed	10 knots
Target range	8 nautical miles
Bearing of target	000°
Relative course of target	180°
Relative speed of target	20 knots

Scenario 2

Own ship course	000°
Own ship speed	10 knots
Target range	1 nautical mile
Bearing of target	000°
Relative course of target	090°
Relative speed of target	10 knots

Scenario 3

Own ship course	000°
Own ship speed	5 knots
Target range	8 nautical miles
Bearing of target	045°
Relative course of target	225°
Relative speed of target	20 knots

Scenario 4

Own ship course	000°
Own ship speed	25 knots
Target range	8 nautical miles
Bearing of target	045°
Relative course of target	225°
Relative speed of target	20 knots

Appendix 3
SENSOR ERRORS

The accuracy figures quoted in paragraph 3.8 are based upon the following sensor errors and are appropriate to equipment complying with performance standards for shipborne navigational equipment.

Note: σ means "standard deviation".

Radar

Target glint (scintillation) (for 200 m length target)
Along length of target $\sigma = 30$ m (normal distribution)
Across beam of target $\sigma = 1$ m (normal distribution)

Roll/pitch bearing. The bearing error will peak in each of the four quadrants around own ship for targets on relative bearings of 045°, 135°, 225° and 315° and will be zero at relative bearings of 000°, 090°, 180° and 270°. This error has a sinusoidal variation at twice the roll frequency.

For a 10° roll the mean error is 0.22° with a 0.22° peak sine wave superimposed.

Beam shape - assumed normal distribution giving bearing error with $\sigma = 0.05°$

Pulse shape - assumed normal distribution giving range error with $\sigma = 20$ m

Antenna backlash - assumed rectangular distribution giving bearing error $\pm$ 0.05° maximum

Quantization

Bearing - rectangular distribution $\pm$0.1° maximum
Range - rectangular distribution $\pm$0.01 nautical miles maximum

Bearing encoder assumed to be running from a remote synchro giving bearing errors with a normal distribution $\sigma = 0.03°$.

Gyro-compass

Calibration error 0.5°
Normal distribution about this with $\sigma = 0.12°$

Log

Calibration error 0.5 knots;
Normal distribution about this, $3\sigma = 0.2$ knots.

PERFORMANCE STANDARDS FOR AUTOMATIC RADAR PLOTTING AIDS (ARPAs)*

Valid for equipment on or after 1 January 1997

1 INTRODUCTION

1.1 Automatic radar plotting aids (ARPAs) should, in order to improve the standard of collision avoidance at sea:

.1 reduce the workload of observers by enabling them automatically to obtain information about plotted targets, so that they can perform as well with several separate targets as they can by manually plotting a single target; and

.2 provide continuous, accurate and rapid situation evaluation.

1.2 The radar facilities provided by an ARPA display should comply with the performance standards for radar equipment (resolution A.477(XII)) appropriate to its mode of use.

1.3 In addition to the general requirements contained in resolution A.694(17), ARPA should comply with the following minimum performance standards.

2 DEFINITIONS

Definitions of terms used in these performance standards are given in appendix 1.

3 PERFORMANCE STANDARDS

3.1 Detection

Where a separate facility is provided for detection of targets, other than by the radar observer, it should have a performance not inferior to that which could be obtained by the use of the radar display.

3.2 Acquisition

3.2.1 Target acquisition may be manual or automatic for relative speeds up to 100 knots. However, there should always be a facility to provide for manual acquisition and cancellation: ARPA with automatic acquisition should have a facility to suppress acquisition in certain areas. On any range scale where acquisition is suppressed over a certain area, the area of acquisition should be defined and indicated on the display.

3.2.2 Automatic or manual acquisition should have a performance not inferior to that which could be obtained by the user of the radar display.

* Annex of Assembly resolution A.823(19)

3.3 Tracking

3.3.1 The ARPA should be able automatically to track, process, simultaneously display and continuously update the information on at least 20 targets, whether automatically or manually acquired.

3.3.2 If automatic acquisition is provided, description of the criteria of selection of targets for tracking should be provided to the user. If the ARPA does not track all targets visible on the display, targets which are being tracked should be clearly indicated with the relevant symbol* on the display. The reliability of tracking should not be less than that obtainable using manual recordings of successive target positions obtained from the radar display.

3.3.3 The ARPA should continue to track an acquired target which is clearly distinguishable on the display for 5 out of 10 consecutive scans, provided the target is not subject to target swop.

3.3.4 The possibility of tracking errors, including target swop, should be minimized by ARPA design. A qualitative description of the effects of error sources on the automatic tracking and corresponding errors should be provided to the user, including the effects of low signal-to-noise and low signal-to-clutter ratios caused by sea returns, rain, snow, low clouds and non-synchronous emissions.

3.3.5 The ARPA should be able to display on request with relevant symbol* at least four equally time-spaced past positions of any targets being tracked over a period appropriate to the range scale in use. The time-scale of the past position plot should be indicated. The operating manual should contain an explanation of what the past position plots represent.

3.4 Display

3.4.1 The display may be a separate or integral part of the ship's radar. However, the ARPA display should include all the data required to be provided by a radar display in accordance with the performance standards for navigational radar equipment.

3.4.2 The design should be such that any malfunction of ARPA parts producing data additional to information to be produced by the radar as required by the performance standards for navigational equipment should not affect the integrity of the basic radar presentation.

3.4.3 The ARPA facilities should be available on at least 3, 6 and 12 nautical mile range scales, and there should be a positive indication of the range scale in use.

3.4.4 ARPA facilities may also be provided on other range scales permitted by resolution A.477(XII) and, if provided, should comply with these standards.

3.4.5 The ARPA should be capable of operating with a relative motion display with "north-up" and "course-up" azimuth stabilization. In addition, the ARPA may also provide for a true motion display. If true motion is provided, the operator should be able to select for the display either true or relative motion. There should be a positive indication of the display mode and orientation in use.

*Refer to IEC Publication 872: Marine Automatic Radar Plotting Aids (ARPAs).

3.4.6 The course and speed information generated by the ARPA for acquired targets should be displayed in a vector or graphic form which clearly indicates the target's predicted motion with relevant symbols*. In this regard:

.1 an ARPA presenting predicted information in vector form only should have the option of both true and relative vectors. There should be an indication of the vector mode selected and, if true vector mode is selected, the display should show whether it is sea or ground stabilized;

.2 an ARPA which is capable of presenting target course and speed information in graphic form should also, on request, provide the target's true and/or relative vector;

.3 vectors displayed should be time-adjustable;

.4 a positive indication of the time-scale of the vector in use should be given; and

.5 if stationary targets are being used for ground referencing, this fact should be indicated by the relevant symbol*. In this mode, relative vectors including those of the targets used for ground referencing should be displayed when requested.

3.4.7 The ARPA information should not obscure the visibility of radar targets. The display of ARPA data should be under the control of the radar observer. It should be possible to cancel the display of unwanted ARPA data within 3 s.

3.4.8 Means should be provided to adjust independently the brilliance of the ARPA data and radar data, including complete extinction of the ARPA data.

3.4.9 The method of presentation should ensure that the ARPA data are clearly visible in general to more than one observer in the conditions of light normally experienced on the bridge of a ship by day and by night. Screening may be provided to shade the display from sunlight but not to the extent that it will impair the observer's ability to maintain a proper look-out. Facilities to adjust the brightness should be provided.

3.4.10 Provisions should be made to obtain quickly the range and bearing of any object which appears on the ARPA display.

3.4.11 When a target appears on the radar display and, in the case of automatic acquisition, enters within the acquisition area chosen by the observer or, in the case of manual acquisition, has been acquired by the observer, the ARPA should present in a period of not more than 1 min an indication of the target's motion trend, and display within 3 min the target's predicted motion in accordance with 3.4.6, 3.6, 3.8.2 and 3.8.3.

3.4.12 After changing range scales on which the ARPA facilities are available or resetting the display, full plotting information should be displayed within a period of time not exceeding one scan.

*Refer to IEC Publication 872

3.5 Operational warnings

3.5.1 The ARPA should have the capability to warn the observer with a visual and audible signal of any distinguishable target which closes to a range or transits a zone chosen by the observer. The target causing the warning should be clearly indicated with relevant symbols* on the display.

3.5.2 The ARPA should have the capability to warn the observer with a visual and audible signal of any tracked target which is predicted to close within a minimum range and time chosen by the observer. The target causing the warning should be clearly indicated with relevant symbols* on the display.

3.5.3 The ARPA should clearly indicate if a tracked target is lost, other than out of range, and the target's last tracked position should be clearly indicated on the display.

3.5.4 It should be possible for the observer to activate or de-activate the audible warning signal.

3.6 Data requirements

3.6.1 The observer should be able to select any tracked target to obtain data. Targets selected should be marked with the relevant symbol* on the radar display. If data is required for more than one target at the same time each symbol should be separately identified, for example with a number adjacent to the symbol*.

3.6.2 The following data for each selected target should be clearly and unambiguously identified and displayed immediately and simultaneously in alpha-numeric form outside the radar area:

.1 present range of the target;

.2 present bearing of the target;

.3 predicted target range at the closest point of approach (CPA);

.4 predicted time to CPA (TCPA);

.5 calculated true course of the target; and

.6 calculated true speed of the target.

3.6.3 The display of the data in 3.6.2.5 and 3.6.2.6 should include an identification of whether the data provided is referenced to sea or ground stabilization.

3.6.4 When data for several targets is displayed, no fewer than two items listed in 3.6.2 should be displayed simultaneously for each target selected. If the items of data are displayed in pairs for each target, the groupings should be 3.6.2.1 with 3.6.2.2, 3.6.2.3 with 3.6.2.4, and 3.6.2.5 with 3.6.2.6.

*Refer to IEC Publication 872

3.7 Trial manoeuvre

3.7.1 The ARPA should be capable of simulating the effect on all tracked targets of an own ship manoeuvre with or without time delay before manoeuvre without interrupting the updating of target tracking and display of actual target alpha-numeric data. The simulation should be indicated with the relevant symbol* on the display.

3.7.2 The operating manual should contain an explanation of the principles underlying the trial manoeuvre technique adopted including, if provided, the simulation of own ship's manoeuvring characteristics.

3.7.3 It should be possible to cancel a trial manoeuvre at any time.

3.8 Accuracy

3.8.1 The ARPA should provide accuracies not less than those given in 3.8.2 and 3.8.3 for the four scenarios defined in appendix 2. With the sensor errors specified in appendix 3, the values given relate to the best possible manual plotting performance under environmental conditions of ± 10 degrees of roll.

3.8.2 An ARPA should present within one minute of steady state tracking the relative motion trend of a target with the following accuracy values (95% probability values).

Data / **Scenario**	**Relative course** (degrees)	**Relative speed** (knots)	**CPA** (nautical miles)
1	11	2.8	1.6
2	7	0.6	-
3	14	2.2	1.8
4	15	1.5	2.0

Note 1: In steady state tracking both own and target ship follow straight line course at constant speed.

Note 2: Probability values are the same as confidence levels.

3.8.3 An ARPA should present within three minutes of steady state tracking the motion of a target with the following accuracy values (95% probability values).

Data / **Scenario**	**Relative course** (degrees)	**Relative speed** (knots)	**CPA** (nautical miles)	**TCPA** (min)	**True course** (degrees)	**True speed** (knots)
1	3.0	0.8	0.5	1.0	7.4	1.2
2	2.3	0.3	-	-	2.8	0.8
3	4.4	0.9	0.7	1.0	3.3	1.0
4	4.6	0.8	0.7	1.0	2.6	1.2

3.8.4 When a tracked target, or own ship, has completed a manoeuvre, the system should present in a period of not more than 1 min an indication of the target's motion trend, and display within 3 min the target's predicted motion, in accordance with 3.4.6, 3.6, 3.8.2 and 3.8.3. In this context, a "manoeuvre of own ship" should be deemed to consist of an alteration of course of $\pm$ 45° in 1 min.

3.8.5 The ARPA should be designed in such a manner that under the most favourable conditions of own ship's motion the error contribution from the ARPA should remain insignificant compared to the errors associated with the input sensors, for the scenarios of appendix 2.

3.9 Connections with other equipment

3.9.1 The ARPA should not degrade the performance of any equipment providing sensor inputs, and the connection of the ARPA to any other equipment should not degrade the performance of that equipment. This requirement should be met whether the ARPA is operating or not. Additionally, the ARPA should be designed to comply with this requirement under fault conditions as far as is practicable.

3.9.2 The ARPA should provide an indication when any input from an external sensor is absent. The ARPA should also repeat any alarm or status messages concerning the quality of the input data from its external sensors which may influence its operation.

3.10 Performance tests and warnings

The ARPA should provide suitable warnings of ARPA mulfunction to enable the observer to monitor the proper operation of the system. Additionally, test programmes should be available so that the overall performance of ARPA can be assessed periodically against a known solution. When a test programme is being executed, the relevant test symbols* should be displayed.

3.11 Sea and ground stabilization

3.11.1 The ARPA should be capable of sea and ground stabilization.

3.11.2 Log and speed indicators providing inputs to ARPA equipment should be capable of providing the ship's speed through the water in the fore and aft direction.

3.11.3 The ground stabilized input may be provided from the log, from an electronic position-fixing system, if the speed measurement accuracy is in accordance with the requirements of resolution A.824(19), or from tracked stationary targets.

3.11.4 The type of input and stabilization in use should be displayed.

*Refer to IEC Publication 872.

APPENDIX 1

DEFINITIONS OF TERMS TO BE USED IN CONNECTION WITH ARPA PERFORMANCE STANDARDS

1. *Target* means any object fixed or moving whose position and motion is determined by measurements of range and bearing on radar.

2. *Relative course* means the direction of motion of a target relative to own ship's position expressed as an angular displacement from north. It is deduced from a number of measurements of target range and bearing on own ship's radar.

3. *Relative speed* means the speed of a target relative to own ship's position. It is deduced from a number of measurements of target range and bearing on own ship's radar.

4. *Relative motion* means the combination of relative course and relative speed.

5. *True course* means the true direction of motion of a target expressed as an angular displacement from north. It is obtained by a vector combination of target relative motion and own ship's true motion.*

6. *True speed* means the speed of a target obtained by a vector combination of target relative motion and own ship's true motion.*

7. *True motion* means the combination of true course and true speed.

8. *True bearing* means the direction of a target from own ship or from another target expressed as an angular displacement from north.

9. *Relative bearing* means the direction of a target from own ship expressed as an angular displacement from own ship's heading.

10. *True motion display* means a display across which own ship and each target moves with its own true motion.

11. *Relative motion* display means a display on which the position of own ship remains fixed and all targets move relative to own ship.

12. *Azimuth stabilized display* means a display in which the azimuth orientation relative to a nominated true bearing is fixed.

13. *North-up display* means an azimuth stabilized display in which a line connecting the centre with the top of the display is north true bearing.

14. *Course-up display* means an azimuth stabilized display in which a line connecting the centre with the top of the display is own ship's intended course.

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*For the purposes of these definitions there is no need to distinguish between sea and ground stabilization.

15. *Heading* means the direction in which the bows of a ship are pointing expressed as an angular displacement from north.

16. *Target's predicted motion* means a prediction of future target motion based on linear extrapolation from its present motion as determined by past measurements of its range and bearing on the radar.

17. *Relative vector* means the predicted movement of a target relative to own ship.

18. *True vector* means the predicted true motion of a target as a result of own ship's direction and speed input. The true vector may be either displayed with reference to the water or to the ground.

19. *Acquisition* means the process of selecting a target or targets and initiating their tracking.

20. *Tracking* means the computer process of observing the sequential changes in the position of a target in order to establish its motion.

21. *Target swop* means a situation in which the incoming radar data for a tracked target becomes incorrectly associated with another tracked target or a non-tracked radar echo.

22. *Acquisition area* means an area set up by the observer which should automatically acquire a target when it enters such an area.

23. *History* means equally time-spaced past position of a target which is being tracked. The history may be relative or true.

24. *Trails* means tracks displayed by the radar echoes of targets in the form of a synthetic afterglow. The trails may be either relative or true. The true trails may be sea or ground stabilized.

25. *Echo reference* means a facility for indicating that a particular fixed navigational mark which is being tracked is to be used as a ground stabilized reference.

26. *Trial manoeuvre* means a facility to assist the observer in making the correct manoeuvre for navigation and collision avoidance purposes.

27. *Suppressed area* means an area set up by the observer within which targets are not acquired.

28. *ERBL* means the electronic range and bearing line used to measure bearings and/or ranges.

29. *CPA/TCPA* stands for closest point of approach (CPA) and time to closest point of approach (TCPA) limits from own ship as defined by the observer, to give warning of when a tracked target or targets will close to within these limits.

30. *Bow passing prediction* is the situation associated with a target which is crossing or predicted to cross ahead of own ship.

31. *Bad echo* is the name associated with a tracked target which appears to have been temporarily lost or which has a poorly defined radar aspect, so that it does not have tracking ability.

32. *Lost target* is the name associated with a target that is no longer being tracked due to having been lost or obscured.

33. *Sea stabilization* is a mode of display whereby own ship and all targets are referenced to the sea, using gyro heading and single axis log water speed inputs.

34. *Ground stabilization* is a mode of display whereby own ship and all targets are referenced to the ground, using ground track or set and drift inputs.

35. *Predicted points of collision* is a graphical representation of where predicted collision intercept points lie with respect to own ship and other targets.

36. *PAD* means the predicted area of danger defined around a predicted close quarter situation area. The size is determined by speed ratios between own ship and the target in question and CPA distance limits as defined by the observer.

37. *Map lines* means the navigational facility whereby the observer can define lines to indicate channels or Traffic Separation Schemes. Sometimes called Nav lines, these lines require ground stabilization to stop them drifting.

Note: Where reference is made to target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA), these measurements are made with respect to the radar antenna.

APPENDIX 2

OPERATIONAL SCENARIOS

For each of the following scenarios, predictions are made at the target position defined after previously tracking for the appropriate time of one or three minutes:

Scenario 1

Own ship course	000°
Own ship speed	10 knots
Target range	8 nautical miles
Bearing of target	000°
Relative course of target	180°
Relative speed of target	20 knots

Scenario 2

Own ship course	000°
Own ship speed	10 knots
Target range	1 nautical mile
Bearing of target	000°
Relative course of target	090°
Relative speed of target	10 knots

Scenario 3

Own ship course	000°
Own ship speed	5 knots
Target range	8 nautical miles
Bearing of target	045°
Relative course of target	225°
Relative speed of target	20 knots

Scenario 4

Own ship course	000°
Own ship speed	25 knots
Target range	8 nautical miles
Bearing of target	045°
Relative course of target	225°
Relative speed of target	20 knots

APPENDIX 3

SENSOR ERRORS

The accuracy figures quoted in 3.8 of these standards are based upon the following sensor errors, and are appropriate to equipment complying with the performance standards for shipborne navigational equipment.

Note: σ means "standard deviation".

Radar

Target glint (scintillation) (for 200 m length target)

Along length of target σ = 30 m (normal distribution)

Across beam of target σ = 1 m (normal distribution)

Roll/pitch bearing: The bearing error will peak in each of the four quadrants around own ship for targets on relative bearings of 045°, 135°, 225° and 315°, and will be zero at relative bearings of 0°, 90°, 180° and 270°. This error has a sinusoidal variation at twice the roll frequency.

For a 10° roll the mean error is 0.22° with a 0.22° peak sine wave superimposed.

Beam shape - assumed normal distribution giving bearing error with σ = 0.05°

Pulse shape - assumed normal distribution giving range error with σ = 20 m

Antenna backlash - assumed rectangular distribution giving bearing error ± 0.05° maximum

Quantization

Bearing - rectangular distribution ± 0.1° maximum.

Range - rectangular distribution ± 0.01 nautical miles maximum.

Bearing encoder assumed to be running from a remote synchro giving bearing errors with a normal distribution σ = 0.03°.

Gyro-compass

Calibration error 0.5°.

Normal distribution about this with σ = 0.12°.

Log

Calibration error 0.5 knots.

Normal distribution about this, 3σ = 0.2 knots.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR DEVICES TO INDICATE SPEED AND DISTANCE*

Valid for equipment installed before 1 January 1997

1 INTRODUCTION

1.1 Devices to indicate speed and distance required by regulation 12, chapter V, of the 1974 SOLAS Convention, as amended, are intended for general navigational use to provide information on the distance run and the forward speed of the ship, through the water or over the ground. The equipment should function at forward speeds up to the maximum speed of the ship and in water of depth greater than 3 m beneath the keel.

1.2 In addition to the 'general recommended general requirements for electronic navigational aids the equipment should conform to the following minimum performance standards.

2 METHODS OF PRESENTATION

2.1 Speed information may be presented in either analogue or digital form. Where a digital display is used, its incremental steps should not exceed 0.1 knots. Analogue displays should be graduated at least every 0.5 knots and be marked with figures at least every 5 knots. If the display can present the speed of the ship in both forward and reverse directions, the direction of movement should be indicated unambiguously.

2.2 Distance run information should be presented in digital form. The display should cover the range from 0 to not less than 9999.9 nautical miles and the incremental steps should not exceed 0.1 nautical miles. Where practicable, means should be provided for resetting a readout to zero.

2.3 The display should be easily readable by day and by night.

2.4 Means should be provided for feeding distance run information to other equipment fitted on board. The information should be in the form of one contact closure or the equivalent for each 0.005 nautical miles run.

2.5 If equipment is capable of being operated in either the "speed through the water" or "speed over the ground" modes, mode selection and mode indication should be provided.

3 ACCURACY OF MEASUREMENT

3.1 Errors in the indicated speed, when the ship is operating free from shallow water effect, and from the effects of wind, current and tide should not exceed 5% of the speed of the ship, or 0.5 knots, whichever is greater.

3.2 Errors in the indicated distance run, when the ship is operating free from shallow water effect, and from the effects of wind, current and tide should not exceed 5% of the distance run by the ship in 1 h or 0.5 nautical miles in each hour, whichever is greater.

* Annex of Assembly Resolution A.478(XII)

3.3 If the accuracy of devices to indicate speed and distance run can be affected by certain conditions (e.g. sea state and its effects, water temperature, salinity, sound velocity in water, the depth of water under the keel, heel and trim of ship), details of possible effects should be included in the equipment handbook.

4 ROLL AND PITCH

The performance of the equipment should be such that it will meet the requirements of these standards when the ship is rolling up to ± 10° and pitching up to ± 5°.

5 CONSTRUCTION AND INSTALLATION

5.1 The system should be so designed that neither the method of attachment of parts of the equipment to the ship nor damage occurring to any part of the equipment which penetrates the hull could result in the ingress of water to the ship.

5.2 Where any part of the system is designed to extend from and retract into the hull of the ship, the design should ensure that it can be extended, operated normally and retracted at all speeds up to the maximum speed of the ship. Its extended and retracted positions should be clearly indicated at the display position.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR DEVICES TO INDICATE SPEED AND DISTANCE*

Valid for equipment installed between 1 January 1997 and 30 June 2002

1 INTRODUCTION

1.1 Devices to indicate speed and distance are intended for general navigational and ship manoeuvring use. Although the minimum requirement is to provide information on the distance run and the forward speed of the ship through the water or over the ground, additional information on ship's motions other than in the forward axis may be provided. The equipment should comply fully with its performance standard at forward speeds up to the maximum speed of the ship and in water of depth greater than 3 m beneath the keel.

1.2 In addition to the general requirements in resolution A.694(17), devices to indicate speed and distance should comply with the following minimum performance requirements.

2 METHODS OF PRESENTATION

2.1 Speed information may be presented in either analogue or digital form. Where a digital display is used, its incremental steps should not exceed 0.1 knots. Analogue displays should be graduated at least every 0.5 knots and be marked with figures at least every 5 knots. If the display can present the speed of the ship in other than the forward direction, the direction of movement should be indicated unambiguously.

2.2 Distance run information should be presented in digital form. The display should cover the range from 0 to not less than 9999.9 nautical miles and the incremental steps should not exceed 0.1 nautical miles. Where practicable, means should be provided for resetting a readout to zero.

2.3 The display should be easily readable by day and by night.

2.4 Means should be provided for feeding distance run information to other equipment fitted on board. In this regard:

.1 when contact closure is used, forward speed only should be indicated. The information should be in the form of one contact closure (or the equivalent) for each 0.005 nautical miles run; and

.2 when serial digital interface is provided, the information on all speed and distance parameters, including direction, should be provided in the form of a serial stream of digital information conforming to the international protocol for a digital interface for marine equipment use.**

2.5 If equipment is capable of being operated in either the "speed through the water" or "speed over the ground" mode, mode selection and mode indication should be provided.

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* Annex of Assembly Resolution A.824(19)
** Refer to IEC 1162: 1994.

2.6 If the equipment has provision for indicating speeds other than on a single fore and aft axis, then the forward and athwart speed through the water must be provided, and the forward and athwart speed over the ground may be provided as an additional option. Resultant speed and course information may be provided as a switchable option. All such information should clearly indicate the direction, mode and validity status of the displayed information.

3 ACCURACY OF MEASUREMENT

3.1 Errors in the indicated speed, when the ship is operating free from shallow water effect and from the effects of wind, current and tide, should not exceed 2% of the speed of the ship, or 0.2 knots, whichever is greater.

3.2 Errors in the indicated distance run, when the ship is operating free from shallow water effect and from the effects of wind, current and tide, should not exceed 2% of the distance run by the ship in 1 h or 0.2 nautical miles in each hour, whichever is greater.

3.3 If the accuracy of devices to indicate speed and distance run can be affected by certain conditions (e.g. sea state and its effects, water temperature, salinity, sound velocity in water, depth of water under the keel, heel and trim of ship), details of possible effects should be included in the equipment handbook.

4 ROLL AND PITCH

The performance of the equipment should be such that it will meet the requirements of these standards when the ship is rolling up to $\pm$ 10° and pitching up to $\pm$ 5°.

5 CONSTRUCTION AND INSTALLATION

5.1 The system should be so designed that neither the method of attachment of parts of the equipment to the ship nor damage occurring to any part of the equipment which penetrates the hull could result in the ingress of water to the ship.

5.2 Where any part of the system is designed to extend from and retract into the hull of the ship, the design should ensure that it can be extended, operated normally and retracted at all speeds up to the maximum speed of the ship. Its extended and retracted positions should be clearly indicated at the display position.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR DEVICES TO INDICATE SPEED AND DISTANCE *

Valid for equipment installed on or after 1 July 2002

1 INTRODUCTION

1.1 Devices to measure and indicate speed and distance are intended for general navigational and ship manoeuvring use. The minimum requirement is to provide information on the distance run and the forward speed of the ship through the water or over the ground. Additional information on ship's motions other than in the forward axis may be provided. The equipment should comply fully with its performance standard at forward speeds up to the maximum speed of the ship. Devices measuring speed and distance through the water should meet the performance standard in water of depth greater than 3 m beneath the keel. Devices measuring speed and distance over the ground should meet the performance standard in water of depth greater than 2 m beneath the keel.

1.2 Radar plotting aids/track control equipment require a device capable of providing speed through the water in the fore and aft direction.

1.3 In addition to the general requirements in resolution A.694(17), devices to measure and indicate speed and distance should comply with the following minimum performance requirements.

2 METHODS OF PRESENTATION

2.1 Speed information may be presented in either analogue or digital form. Where a digital display is used, its incremental steps should not exceed 0.1 knots. Analogue displays should be graduated at least every 0.5 knots and be marked with figures at least every 5 knots. If the display can present the speed of the ship in other than the forward direction, the direction of movement should be indicated unambiguously.

2.2 Distance run information should be presented in digital form. The display should cover the range from 0 to not less than 9999.9 nautical miles and the incremental steps should not exceed 0.1 nautical miles. Where practicable, means should be provided for resetting a readout to zero.

2.3 The display should be easily readable by day and by night.

2.4 Means should be provided for transmitting measured speed and distance run information to other equipment fitted on board. In this regard:

.1 the information on all speed and distance parameters, including direction should be transmitted in accordance with the relevant international marine interface standards**; and

.2 additionally, when the equipment is used for measuring forward speed, then the information may be transmitted using closing contacts and, if so, this should be in the form of one contact closure each 0.005 nautical miles run.

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* Annex of MSC resolution MSC.96(72)
** Refer to IEC Publication 61162

2.5 If equipment is capable of being operated in either the "speed through the water" or "speed over the ground" mode, mode selection and mode indication should be provided.

2.6 If the equipment has provision for indicating speeds other than on a single fore and aft direction, then both the forward and athwart speeds should be provided either through the water or over the ground. Resultant speed and direction information may be provided as a display selectable option. All such information should clearly indicate the direction, mode and validity status of the displayed information.

3 ACCURACY OF MEASUREMENT

3.1 Errors in the measured and indicated speed, when the ship is operating free from shallow water effect and from the effects of wind, sea bottom type, current and tide, should not exceed the following:

.1 for a digital display - 2% of the speed of the ship, or 0.2 knots, whichever is greater;

.2 for an analogue display – 2.5% of the speed of the ship, or 0.25 knots, whichever is greater; and

.3 for output data transmission – 2% of the speed of the ship, or 0.2 knots, whichever is greater.

3.2 Errors in the indicated distance run, when the ship is operating free from shallow water effect and from the effects of wind, sea bottom type, current and tide, should not exceed 2% of the distance run by the ship in 1 h or 0.2 nautical miles in each hour, whichever is greater.

3.3 If the accuracy of devices to indicate speed and distance run can be affected in use by certain conditions (e.g. sea state and its effects, water temperature, salinity, sound velocity in water, depth of water under the keel, heel and trim of ship), details of possible effects should be included in the equipment handbook.

4 ROLL AND PITCH

The performance of the equipment should be such that it will meet the requirements of these standards when the ship is rolling up to $\pm$ 10º and pitching up to $\pm$ 5º.

5 CONSTRUCTION AND INSTALLATION

5.1 The system should be so designed that neither the method of attachment of parts of the equipment to the ship nor damage occurring to any part of the equipment which penetrates the hull could result in the ingress of water to the ship.

5.2 Where any part of the system is designed to extend from and retract into the hull of the ship, the design should ensure that it can be extended, operated normally and retracted at all speeds up to the maximum speed of the ship. Its extended and retracted positions should be clearly indicated at the display position.

PERFORMANCE STANDARDS FOR RATE-OF-TURN INDICATORS *

Valid for equipment installed on or after 1 September 1984

1 GENERAL REQUIREMENTS

The rate-of-turn indicator (ROTI) should, in addition to the requirements of these standards, comply with the requirements of resolution A.281(VIII) for shipborne electronic navigational aids.

2 OPERATIONAL STANDARDS

2.1 The ROTI should be capable of indicating rates of turn to starboard and to port of the ship to which it is fitted.

2.2 The ROTI may be self-contained; alternatively it may form part of, or derive information from, any other appropriate equipment.

2.3 Indication

2.3.1 The indication required should be provided by a centre-zero analogue type indicator (preferably circular). Where a circular scale indicator is used, the zero should be uppermost.

2.3.2 A turn of ship to port should be indicated on the left of the zero point and a starboard turn to the right of the zero point. If the actual rate of turn exceeds full scale deflection, this should be clearly indicated on the display.

2.3.3 In addition, an alphanumeric display may be provided. Positive indication of port and starboard should be provided on such displays.

2.3.4 The length of scale in either direction from zero should not be less than 120 mm. The sensitivity of the system should ensure that a change in the rate of turn of l° per minute is represented by a distance of not less than 4 mm on its scale.

2.4 Range scales

2.4.1 A linear range scale of not less than $\pm$30° per minute should be provided. This scale should be marked in intervals of 1° per minute on both sides of zero. The scale should be marked with figures every 10° per minute. Every 10° mark should be significantly longer than the 5° mark which in turn should be significantly longer than the 1° mark. The marks and figures should preferably be red or a light colour on a dark background.

2.4.2 Additional linear range scales may be provided.

* Annex of Assembly resolution A.526(13)

2.4.3 Damping of the ROTI should be provided with a time constant, which may be varied during operation in the range zero to at least 10 s.

2.5 Accuracy

2.5.1 The indicated rate of turn should not deviate from the actual rate of turn of the ship by more than 0.5° per minute plus 5% of the indicated rate of turn of the ship. These values include the influence of earth rate.

2.5.2 Periodic rolling motion of the ship with an amplitude of $\pm$5° and period of up to 25 s and periodic pitching motion with an amplitude of $\pm$1° and period of up to 20 s should not change the mean value of the indicated rate of turn by more than 0.5° per minute.

2.5.3 The ROTI should meet these accuracy requirements at all ship speeds up to 10 knots.

3 OPERATION

3.1 The ROTI should be ready for operation and comply with these standards within 4 min of being switched on.

3.2 The design should be such that whether operating or not the ROTI will not degrade the performance of any other equipment to which it is connected.

3.3 The ROTI should include a means of enabling the operator to verify that it is operating.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR SHIPBORNE GLOBAL POSITIONING SYSTEM RECEIVER EQUIPMENT*

Valid for equipment installed before 1 July 2003

1 INTRODUCTION

1.1 The Global Positioning System (GPS) is a space-based positioning, velocity and time system that has three major segments: space, control and user. The GPS space segment will normally be composed of 24 satellites in six orbits. The satellites operate in circular 20,200 km orbits at an inclination angle of 55° with a 12-hour period. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a position dilution of precision (PDOP) of $\leq$6. Each satellite transmits on two "L" band frequencies, L1 (1575.42 MHz) and L2 (1227.6 MHz). L1 carries a precise (P) code and coarse/acquisition (C/A) code. L2 carries the P code. A navigation data message is superimposed on these codes. The same navigation data message is carried on both frequencies.

1.2 Receiver equipment for the GPS intended for navigational purposes on ships with maximum speeds not exceeding 50 knots should, in addition to the general requirements contained in resolution A.694(17), comply with the following minimum performance requirements.

1.3 These standards cover the basic requirements of position-fixing for navigation purposes only and do not cover other computational facilities which may be in the equipment.

2 GPS RECEIVER EQUIPMENT

2.1 The words "GPS receiver equipment" as used in these performance standards include all the components and units necessary for the system properly to perform its intended functions. The equipment should include the following minimum facilities:

.1 antenna capable of receiving GPS signals;

.2 GPS receiver and processor;

.3 means of accessing the computed latitude/longitude position;

.4 data control and interface; and

.5 position display and, if required, other forms of output.

2.2 The antenna design should be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellation.

* Annex of Assembly resolution A.819(19)

3 PERFORMANCE STANDARDS FOR GPS RECEIVER EQUIPMENT

3.1 The GPS receiver equipment should:

.1 be capable of receiving and processing the Standard Positioning Service (SPS) signals as modified by Selective Availability (SA) and provide position information in latitude and longitude World Geodetic System (WGS) 84 co-ordinates in degrees, minutes and thousandths of minutes and time of solution referenced to UTC. Means may be provided for transforming the computed position based upon WGS 84 into data compatible with the datum of the navigational chart in use. Where this facility exists, the display should indicate that co-ordinate conversion is being performed, and should identify the co-ordinate system in which the position is expressed;

.2 operate on the L1 signal and C/A code;

.3 be provided with at least one output from which position information can be supplied to other equipment. The output of position information based upon WGS 84 should be in accordance with IEC Publication 1162;

.4 have static accuracy such that the position of the antenna is determined to within 100 m (95%) with horizontal dilution of precision (HDOP) $\leq$ 4 (or PDOP $\leq$ 6);

.5 have dynamic accuracy such that the position of the ship is determined to within 100 m (95%) with HDOP $\leq$ 4 (or PDOP $\leq$ 6) under the conditions of sea states and ship's motion likely to be experienced in ships;[*]

.6 be capable of selecting automatically the appropriate satellite-transmitted signals for determining the ship's position with the required accuracy and update rate;

.7 be capable of acquiring satellite signals with input signals having carrier levels in the range of -130 dBm to -120 dBm. Once the satellite signals have been acquired, the equipment should continue to operate satisfactorily with satellite signals having carrier levels down to -133 dBm;

.8 be capable of acquiring position to the required accuracy within 30 min when there is no valid almanac data;

.9 be capable of acquiring position to the required accuracy within 5 min when there is valid almanac data;

.10 be capable of re-acquiring position to the required accuracy within 5 min when the GPS signals are interrupted for a period of at least 24 h but there is no loss of power;

.11 be capable of re-acquiring position to the required accuracy within 2 min when subjected to a power interruption of 60 s;

[*] Refer to resolution A.694(17) and IEC Publications 721-3-6, 945 and 1108-1.

.12 generate and output a new position solution at least once every 2 s;

.13 the minimum resolution of position, i.e. latitude and longitude, should be 0.001 minutes; and

.14 have the facilities to process differential GPS (DGPS) data fed to it in accordance with the standards of Recommendation ITU-R M.823 and the appropriate RTCM standard. When a GPS receiver is equipped with a differential receiver, performance standards for static and dynamic accuracies (3.4 and 3.5 above) should be 10 m (95%).

4 PROTECTION

Precautions should be taken to ensure that no permanent damage can result from an accidental short circuit or grounding of the antenna or any of its input or output connections or any of the GPS receiver equipment inputs or outputs for a duration of 5 min.

5 FAILURE WARNINGS AND STATUS INDICATIONS

5.1 The equipment should provide an indication of whether the position calculated is likely to be outside the requirements of these performance standards.

5.2 The GPS receiver equipment should provide as a minimum:

.1 an indication within 5 s if either:

.1.1 the specified HDOP has been exceeded; or

.1.2 a new position has not been calculated for more than 2 s.

Under such conditions the last known position and the time of the last valid fix, with explicit indication of this state, so that no ambiguity can exist, should be output until normal operation is resumed;

.2 a warning of loss of position; and

.3 differential GPS status indication of:

.3.1 the receipt of DGPS signals; and

.3.2 whether DGPS corrections are being applied to the indicated ship's position.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR SHIPBORNE GLOBAL POSITIONING SYSTEM RECEIVER EQUIPMENT*

Valid for equipment installed on or after 1 July 2003

1 INTRODUCTION

1.1 The Global Positioning System (GPS) is a space-based positioning, velocity and time system that has three major segments: space, control and user. The GPS space segment will normally be composed of 24 satellites in six orbits. The satellites operate in circular 20,200 km orbits at an inclination angle of 55° with a 12-hour period. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a position dilution of precision (PDOP) of ≤ 6. Each satellite transmits on two "L" band frequencies, L1 (1575,42 MHz) and L2 (1227.6 MHz). L1 carries a precise (P) code and coarse/acquisition (C/A) code. L2 carries the P code. A navigation data message is superimposed on these codes. The same navigation data message is carried on both frequencies.

1.2 Receiver equipment for the GPS intended for navigational purposes on ships with maximum speeds not exceeding 70 knots should, in addition to the general requirements contained in resolution A.694(17)**, comply with the following minimum performance requirements.

1.3 These standards cover the basic requirements of position-fixing for navigation purposes only and do not cover other computational facilities which may be in the equipment.

2 GPS RECEIVER EQUIPMENT

2.1 The words "GPS receiver equipment" as used in these performance standards include all the components and units necessary for the system properly to perform its intended functions. The equipment should include the following minimum facilities:

.1 antenna capable of receiving GPS signals;

.2 GPS receiver and processor;

.3 means of accessing the computed latitude/longitude position;

.4 data control and interface; and

.5 position display and, if required, other forms of output.

2.2 The antenna design should be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellation.

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* Annex of MSC resolution MSC.112(73)
** Refer to Publication IEC 60945.

3 PERFORMANCE STANDARDS FOR GPS RECEIVER EQUIPMENT

The GPS receiver equipment should:

.1 be capable of receiving and processing the Standard Positioning Service (SPS) signals as modified by Selective Availability (SA) and provide position information in latitude and longitude World Geodetic System (WGS)-84 co-ordinates in degrees, minutes and thousandths of minutes and time of solution referenced to UTC (USNO). Means may be provided for transforming the computed position based upon WGS-84 into data compatible with the datum of the navigational chart in use. Where this facility exists, the display should indicate that co-ordinate conversion is being performed, and should identify the co-ordinate system in which the position is expressed;

.2 operate on the L1 signal and C/A code;

.3 be provided with at least one output from which position information can be supplied to other equipment. The output of position information based upon WGS-84 should be in accordance with international standards;[*]

.4 have static accuracy such that the position of the antenna is determined to within 100 m (95%) with horizontal dilution of precision (HDOP) $\leq$ 4 (or PDOP $\leq$ 6);

.5 have dynamic accuracy such that the position of the ship is determined to within 100 m (95%) with HDOP $\leq$ 4 (or PDOP $\leq$ 6) under the conditions of sea states and ship's motion likely to be experienced in ships; [**]

.6 be capable of selecting automatically the appropriate satellite-transmitted signals for determining the ship's position with the required accuracy and update rate;

.7 be capable of acquiring satellite signals with input signals having carrier levels in the range of -130 dBm to -120 dBm. Once the satellite signals have been acquired, the equipment should continue to operate satisfactorily with satellite signals having carrier levels down to -133 dBm;

.8 be capable of acquiring position to the required accuracy, within 30 min, when there is no valid almanac data;

.9 be capable of acquiring position to the required accuracy, within 5 min, when there is valid almanac data;

.10 be capable of re-acquiring position to the required accuracy, within 5 min, when the GPS signals are interrupted for a period of at least 24 h but there is no loss of power;

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[*] IEC Publication 61162.

[**] Refer to resolution A.694(17), Publications IEC 6721-3-6, IEC 60945 and IEC 61108-1.

.11 be capable of re-acquiring position to the required accuracy, within 2 min, when subjected to a power interruption of 60 s;

.12 generate and output to a display and digital interface* a new position solution at least once every 1 s;**

.13 have a minimum resolution of position, i.e. latitude and longitude, of 0.001 minutes;

.14 generate and output to the digital interface* course over the ground (COG), speed over the ground (SOG) and universal time co-ordinated (UTC). Such outputs should have a validity mark aligned with that on the position output. The accuracy requirement for COG and SOG should not be inferior to the relevant Performance Standards for Heading*** and SDME;****

.15 have the facilities to process differential GPS (DGPS) data fed to it in accordance with the standards of Recommendation ITU-R M.823 and the appropriate RTCM standard. When a GPS receiver is equipped with a differential receiver, performance standards for static and dynamic accuracies (paragraphs 3.4 and 3.5 above) should be 10 m (95%); and

.16 be capable of operating satisfactorily in typical interference conditions.

4 PROTECTION

Precautions should be taken to ensure that no permanent damage can result from an accidental short circuit or grounding of the antenna or any of its input or output connections or any of the GPS receiver equipment inputs or outputs for a duration of 5 min.

5 FAILURE WARNINGS AND STATUS INDICATIONS

5.1 The equipment should provide an indication of whether the position calculated is likely to be outside the requirements of these performance standards.

5.2 The GPS receiver equipment should provide as a minimum:

.1 an indication within 5 s if either:

.1.1 the specified HDOP has been exceeded; or

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* Conforming to the IEC 61162 series.

** For craft meeting the HSC Code, a new position solution at least every 0.5 s is recommended.

*** Resolution A.424(XI).

**** Resolution A.824(19).

.1.2 a new position has not been calculated for more than 1 s.*

Under such conditions the last known position and the time of the last valid fix, with explicit indication of this state, so that no ambiguity can exist, should be output until normal operation is resumed;

.2 a warning of loss of position;

.3 differential GPS status indication of:

.3.1 the receipt of DGPS signals; and

.3.2 whether DGPS corrections are being applied to the indicated ship's position;

.4 DGPS integrity status and alarm; and

.5 DGPS text message display.

* For craft meeting the HSC Code, a new position solution at least every 0.5 s is recommended.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR SHIPBORNE GLONASS RECEIVER EQUIPMENT*

Valid for equipment installed before 1 July 2003

1 INTRODUCTION

1.1 The Global Navigation Satellite System (GLONASS) is a space-based positioning, velocity, and time system that has three major segments: Space, Control and User. The GLONASS Space Segment, will normally be composed of 24 satellites placed in three orbital planes with eight satellites in each plane. The satellites operate in circular 19100 km orbits at an inclination angle of 64.8° and with an 11 h and 15 min period. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a position dilution of precision (PDOP) of £ 6. Satellites of the system transmit signals on "L" band frequencies. Each satellite has separate lettered frequencies L1 (1602, 5625-1615.5 MHz).

1.2 Each L1 frequency carries a code standard accuracy (C), which is used in shipborne GLONASS receiver equipment. A navigation data message is super-imposed on this code.

1.3 Receiver equipment for the GLONASS intended for navigational purposes on ships with maximum speeds not exceeding 50 knots should, in addition to the general requirements contained in resolution A.694(17), comply with the following minimum performance requirements.

1.4 These standards cover the basic requirements of position-fixing for navigation purposes only and does not cover other computational facilities which may be in the equipment.

2 GLONASS RECEIVER EQUIPMENT

2.1 The words "GLONASS receiver equipment" as used in these performance standards include all the components and units necessary for the system to properly perform its intended functions. The equipment should include the following minimum facilities:

.1 antenna capable of receiving GLONASS signals;

.2 GLONASS receiver and processor;

.3 means of accessing the computed latitude/longitude position;

.4 data control and interface; and

.5 position display and, if required, other forms of output.

2.2 The antenna design should be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellation.

* Annex of MSC resolution MSC.53(66)

3 PERFORMANCE STANDARDS FOR GLONASS RECEIVER EQUIPMENT

The GLONASS receiver equipment should:

.1 be capable of receiving and processing the Standard Positioning Service (SPS) signals of the GLONASS system and provide position information in latitude and longitude SGS-90 co-ordinates in degrees, minutes and thousandths of minutes and time of solution referenced to UTC (SU). Means should be provided to transform the computed position based upon SGS-90 into WGS 84 or into data compatible with the datum of the navigational chart in use. Where this facility exists, the display should indicate that the co-ordinate conversion is being performed and should identify the co-ordinate system in which the position is expressed;

.2 operate on the Standard Positioning Service (on lettered L1 frequencies and C code);

.3 be provided with at least one output from which position information can be supplied to other equipment. The output of position information based upon SGS-90 or WGS 84, should be in accordance with IEC Publication 1162;

.4 have static accuracy such that the position of the antenna is determined to within 100 m (95%) with horizontal dilution of position (HDOP) $\leq$ 4 (PDOP $\leq$ 6);

.5 have dynamic accuracy such that the position of the antenna is determined to within 100 m (95%) with horizontal dilution of position (HDOP) $\leq$ 4 (PDOP $\leq$ 6) under the conditions of sea states and ship's motion likely to be experienced in ships;[*]

.6 be capable of selecting automatically the appropriate satellite transmitted signals for determination of the ship's position with the required accuracy and update rate;

.7 be capable of acquiring satellite signals with input signals having carrier levels in the range of - 130 dBm to - 120 dBm. Once the satellite signals have been acquired the equipment should continue to operate satisfactorily with satellite signal having carrier levels down to - 133 dBm;

.8 be capable of acquiring position to the required accuracy, within 30 min, when there is no valid almanac data;

.9 be capable of acquiring position to the required accuracy, within 5 min, when there is valid almanac data;

.10 be capable of re-acquiring position to the required accuracy, within 5 min when the GLONASS signals are interrupted for a period of at least 24 h, but there is no loss of power;

[*] Resolution A.694(17), Publications IEC 721-3-6, IEC 945 and IEC 1108-2

.11 be capable of re-acquiring position to the required accuracy, within 2 min, when subjected to a power interruption of 60 s;

.12 generate and output a new position solution at least once every 2 s;

.13 the minimum resolution of position, i.e. latitude and longitude should be 0.001 min; and

.14 have the facilities to receive and process differential GLONASS (DGLONASS) data fed to it in accordance with the standards of Recommendation ITU-R M.823. When a GLONASS receiver is equipped with a differential receiver, performance standards for static and dynamic accuracies (.4 and .5 above) should be 10 m (95%).*

4 PROTECTION

Precautions should be taken to ensure that no permanent damage can result from an accidental short circuit or grounding of the antenna or any of its input or output connections or any of the GLONASS receiver equipment inputs or outputs for a duration of 5 min.

5 FAILURE WARNINGS AND STATUS INDICATIONS

5.1 The equipment should provide an indication if the position calculated is likely to be outside of the requirements of these performance standards.

5.2 The GLONASS receiver equipment should provide as a minimum:

.1 an indication within 5 s if either:

.1.1 the specified HDOP has been exceeded; or

.1.2 a new position has not been calculated for more than 2 s.

Under such conditions the last known position and the time of the last valid fix, with explicit indication of this state, so that no ambiguity can exist, should be output until normal operation is resumed;

.2 a warning of loss of position; and

.3 differential GLONASS status indication of:

.3.1 the receipt of DGLONASS signals; and

.3.2 whether DGLONASS corrections are being applied to the indicated ship's position.

* Refer to resolution A.815(19) on the World-wide Radionavigation System, adopted by the Organization.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR SHIPBORNE GLONASS RECEIVER EQUIPMENT*

Valid for equipment installed on or after 1 July 2003

1 INTRODUCTION

1.1 The Global Navigation Satellite System (GLONASS) is a space-based positioning, velocity, and time system that has three major segments: Space, Control and User. The GLONASS Space Segment, will normally be composed of 24 satellites placed in three orbital planes with eight satellites in each plane. The satellites operate in circular 19,100 km orbits at an inclination angle of 64.8° and with an 11 h and 15 min period. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a position dilution of precision (PDOP) of $\leq$6. Satellites of the system transmit signals on "L" band frequencies. Each satellite has separate lettered frequencies L1 (1602, 5625-1615.5 MHz).

1.2 Each L1 frequency carries a code standard accuracy (C), which is used in shipborne GLONASS receiver equipment. A navigation data message is superimposed on this code.

1.3 Receiver equipment for the GLONASS intended for navigational purposes on ships with maximum speeds not exceeding 70 knots should, in addition to the general requirements contained in resolution A.694(17)**, comply with the following minimum performance requirements.

1.4 These standards cover the basic requirements of position-fixing for navigation purposes only and does not cover other computational facilities which may be in the equipment.

2 GLONASS RECEIVER EQUIPMENT

2.1 The words "GLONASS receiver equipment" as used in these performance standards include all the components and units necessary for the system to properly perform its intended functions. The equipment should include the following minimum facilities:

.1 antenna capable of receiving GLONASS signals;

.2 GLONASS receiver and processor;

.3 means of accessing the computed latitude/longitude position;

.4 data control and interface; and

.5 position display and, if required, other forms of output.

2.2 The antenna design should be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellation.

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* Annex of MSC resolution MSC.113(73)
** Refer to IEC Publication 60945.

3 PERFORMANCE STANDARDS FOR GLONASS RECEIVER EQUIPMENT

The GLONASS receiver equipment should:

.1 be capable of receiving and processing the Standard Positioning Service (SPS) signals of the GLONASS system and provide position information in latitude and longitude PZ-90 co-ordinates in degrees, minutes and thousandths of minutes and time of solution referenced to UTC (SU). Means should be provided to transform the computed position based upon PZ-90 into WGS-84 or into data compatible with the datum of the navigational chart in use. Where this facility exists, the display should indicate that the co-ordinate conversion is being performed and should identify the co-ordinate system in which the position is expressed;

.2 operate on the Standard Positioning Service (on lettered L1 frequencies and C code);

.3 be provided with at least one output from which position information can be supplied to other equipment. The output of position information based upon PZ-90 or WGS-84, should be in accordance with international standards;[*]

.4 have static accuracy such that the position of the antenna is determined to within 45 m (95%) with horizontal dilution of position (HDOP) ≤ 4 (PDOP ≤ 6);

.5 have dynamic accuracy such that the position of the antenna is determined to within 45 m (95%) with horizontal dilution of position (HDOP) ≤ 4 (PDOP ≤ 6) under the conditions of sea states and ship's motion likely to be experienced in ships;[**]

.6 be capable of selecting automatically the appropriate satellite transmitted signals for determination of the ship's position with the required accuracy and update rate;

.7 be capable of acquiring satellite signals with input signals having carrier levels in the range of - 130 dBm to - 120 dBm. Once the satellite signals have been acquired the equipment should continue to operate satisfactorily with satellite signal having carrier levels down to - 133 dBm;

.8 be capable of acquiring position to the required accuracy, within 30 min, when there is no valid almanac data;

.9 be capable of acquiring position to the required accuracy, within 5 min, when there is valid almanac data;

.10 be capable of re-acquiring position to the required accuracy, within 5 min, when the GLONASS signals are interrupted for a period of at least 24 h, but there is no loss of power;

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[*] IEC Publication 61162.

[**] Resolution A.694(17), Publications IEC 6721 3-6, IEC 60945 and IEC 61108-2.

.11 be capable of re-acquiring position to the required accuracy, within 2 min, when subjected to a power interruption of 60 s;

.12 generate and output to a display and digital interface* a new position solution at least once every 1 s;**

.13 have a minimum resolution of position, i.e. latitude and longitude of 0.001 minutes;

.14 generate and output to the digital interface* course over the ground (COG), speed over the ground (SOG) and universal time co-ordinated (UTC). Such outputs should have a validity mark aligned with that on the position output. The accuracy requirement for COG and SOG should not be inferior to the relevant Performance Standards for Heading*** and SDME;****

.15 have the facilities to receive and process differential GLONASS (DGLONASS) data fed to it in accordance with the standards of Recommendation ITU-R M.823. When a GLONASS receiver is equipped with a differential receiver, performance standards for static and dynamic accuracies (paragraphs 3.4 and 3.5 above) should be 10 m (95%);***** and

.16 be capable of operating satisfactorily in typical interference conditions.

4 PROTECTION

Precautions should be taken to ensure that no permanent damage can result from an accidental short circuit or grounding of the antenna or any of its input or output connections or any of the GLONASS receiver equipment inputs or outputs for a duration of 5 min.

5 FAILURE WARNINGS AND STATUS INDICATIONS

5.1 The equipment should provide an indication if the position calculated is likely to be outside of the requirements of these performance standards.

5.2 The GLONASS receiver equipment should provide as a minimum:

.1 an indication within 5 s if either:

.1.1 the specified HDOP has been exceeded; or

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* Publication IEC 61162 series.

** For craft meeting the HSC Code, a new position solution at least every 0.5 s is recommended.

*** Resolution A.424(XI).

**** Resolution A.824(19).

***** Refer to resolution A.815(19) on the World-wide Radionavigation System.

.1.2 a new position has not been calculated for more than 1 s.*

Under such conditions the last known position and the time of the last valid fix, with explicit indication of this state, so that no ambiguity can exist, should be output until normal operation is resumed;

.2 a warning of loss of position;

.3 differential GLONASS status indication of:

.3.1 the receipt of DGLONASS signals; and

.3.2 whether DGLONASS corrections are being applied to the indicated ship's position;

.4 DGLONASS integrity status and alarm; and

.5 DGLONASS text message display.

* For craft meeting the HSC Code, a new position solution at least every 0.5 s is recommended.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR COMBINED GPS/GLONASS RECEIVER EQUIPMENT*

Valid for equipment installed between 1 January 2000 and 30 June 2003

1 INTRODUCTION

1.1 The Global Positioning System (GPS) and Global Navigation Satellite System (GLONASS) are space-based positioning, velocity and time systems. The GPS space segment will normally be composed of 24 satellites in six orbits. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a position dilution of precision (PDOP) $\leq$ 6. The GLONASS space segment will normally be composed of 24 satellites placed in 3 orbital planes with 8 satellites in each plane. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a PDOP $\leq$ 6.

1.2 A combined receiver, when compared to either the GPS or GLONASS receiver, offers improved availability, integrity, accuracy and resistance to interference; increased ease of installation, and the ability to operate in the differential GPS mode (DGPS), differential GLONASS mode (DGLONASS) and combined DGPS and DGLONASS mode, when available.

1.3 Receiver equipment capable of combining individual satellite measurements from GPS and GLONASS constellations to form a single solution is intended for navigational purposes on ships with maximum speeds not exceeding 50 knots. Such equipment should, in addition to the general requirements contained in resolution A.694(17), comply with the following minimum performance requirements.

1.4 These standards cover the basic requirements of position-fixing for navigation purposes only and do not cover other computational facilities which may be in the equipment.

2 COMBINED GPS/GLONASS RECEIVER EQUIPMENT

2.1 The words "combined GPS/GLONASS receiver equipment" as used in these performance standards include all the components and units necessary for the system to properly perform its intended functions. The equipment should include the following minimum facilities:

.1 antenna capable of receiving both GPS and GLONASS signals;

.2 combined GPS/GLONASS receiver and processor;

.3 means of accessing the computed latitude/longitude position;

.4 data control and interface; and

.5 position display.

* Annex 1 of MSC resolution MSC.74(69)

2.2 The antenna design should be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellations.

3 PERFORMANCE STANDARDS FOR COMBINED GPS/GLONASS RECEIVER EQUIPMENT

3.1 The combined GPS/GLONASS receiver equipment should:

.1.1 be capable of receiving and processing the Standard Positioning Service (SPS) signals of the GPS as modified by Selective Availability (SA) and range code signals in GLONASS and provide position information in latitude and longitude World Geodetic System (WGS) 84 co-ordinates in degrees, minutes and thousandths of minutes. Means may be provided to transform the computed position into data compatible with the datum of the navigational chart in use. Where this facility exists, the display and any data output should indicate that the co-ordinate conversation is being performed and should identify the co-ordinate system in which the position is expressed;

.1.2 operate on the L1 frequency signal and C/A code in GPS and L1 frequency signal and range code in GLONASS;

.1.3 be provided with at least one output from which position information can be supplied to other equipment. The output of position information should be in accordance with the relevant international standard;*

.1.4 have static accuracy such that the position of the antenna is determined to within 35 m (95%) in non-differential mode and 10 m (95%) in differential mode with horizontal dilution of precision (HDOP) $\leq$ 4 or position dilution of precision (PDOP) $\leq$ 6;

.1.5 have dynamic accuracy such that the position of the ship is determined to within 35 m (95%) in non-differential mode and 10 m (95%) in differential mode with HDOP $\leq$ 4 or PDOP $\leq$ 6 under the conditions of sea states and ship's motion likely to be experienced in ships**;

.1.6 be capable of selecting automatically the appropriate satellite transmitted signals for determination of the ship's position with the required accuracy and update rate;

.1.7 be capable of acquiring satellite signals with input signals having carrier levels in the range of -130 dBm to -120 dBm. Once the satellite signals have been acquired the equipment should continue to operate satisfactorily with satellite signals having carrier levels down to -133 dBm;

.1.8 be capable of acquiring position to the required accuracy, within 30 min, when there is no valid almanac data;

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* IEC 1162 Publication
** Resolution A.694(17); IEC 721-3-6, IEC 945 and IEC 1108-3 Publications

.1.9 be capable of acquiring position to the required accuracy, within 5 min, when there is valid almanac data;

.1.10 be capable of re-acquiring position to the required accuracy, within 5 min, when all GPS and GLONASS signals are interrupted for a period of at least 24 h, but there is no loss of power;

.1.11 be capable of re-acquiring position to the required accuracy, within 2 min, when subjected to a power interruption of 60 s;

.1.12 be capable of re-acquiring an individual satellite signal and utilizing it in the position solution within 10 s after being blocked for 30 s;

.1.13 generate and output a new position solution at least once every 1 s;

.1.14 have a minimum resolution of position, i.e. latitude and longitude of 0.001 min; and

.1.15 have the facilities to process DGPS and DGLONASS data fed to it, in accordance with Recommendation ITU-R M.823 and the appropriate RTCM standard.

4 PROTECTION

Precautions should be taken to ensure that no permanent damage can result from an accidental short circuit or grounding of the antenna or any of its input or output connections or any of the combined GPS/GLONASS receiver equipment inputs or outputs for a duration of 5 min.

5 FAILURE WARNINGS AND STATUS INDICATIONS

5.1 The equipment should provide an indication if the position calculated is likely to be outside of the requirements of these performance standards.

5.2 The combined GPS/GLONASS receiver equipment should provide as a minimum:

.1 an indication within 5 s if either:

a) the specified HDOP has been exceeded; or

b) a new position has not been calculated for more than 1 s.

Under such conditions the last known position and the time of the last valid fix, with explicit indication of this state, so that no ambiguity can exist, should be output until normal operation is resumed;

.2 a warning of loss of position; and

.3 DGPS and DGLONASS status indication of:

a) the receipt of DGPS and DGLONASS signals; and

b) whether DGPS and DGLONASS corrections are being applied to the indicated ship's position.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR COMBINED GPS/GLONASS RECEIVER EQUIPMENT*

Valid for equipment installed on or after 1 July 2003

1 INTRODUCTION

1.1 The Global Positioning System (GPS) and Global Navigation Satellite System (GLONASS) are space-based positioning, velocity and time systems. The GPS space segment will normally be composed of 24 satellites in six orbits. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a position dilution of precision (PDOP) $\leq$ 6. The GLONASS space segment will normally be composed of 24 satellites placed in 3 orbital planes with 8 satellites in each plane. The spacing of satellites in orbit will be arranged so that a minimum of four satellites will be in view to users world-wide, with a PDOP $\leq$ 6.

1.2 A combined receiver, when compared to either the GPS or GLONASS receiver, offers improved availability, integrity, accuracy and resistance to interference; increased ease of installation, and the ability to operate in the differential GPS mode (DGPS), differential GLONASS mode (DGLONASS) and combined DGPS and DGLONASS mode, when available.

1.3 Receiver equipment capable of combining individual satellite measurements from GPS and GLONASS constellations to form a single solution is intended for navigational purposes on ships with maximum speeds not exceeding 70 knots. Such equipment should, in addition to the general requirements contained in resolution A.694(17)**, comply with the following minimum performance requirements.

1.4 These standards cover the basic requirements of position-fixing for navigation purposes only and do not cover other computational facilities which may be in the equipment.

2 COMBINED GPS/GLONASS RECEIVER EQUIPMENT

2.1 The words "combined GPS/GLONASS receiver equipment" as used in these performance standards include all the components and units necessary for the system to properly perform its intended functions. The equipment should include the following minimum facilities:

.1 antenna capable of receiving both GPS and GLONASS signals;

.2 combined GPS/GLONASS receiver and processor;

.3 means of accessing the computed latitude/longitude position;

.4 data control and interface; and

.5 position display.

* Annex of MSC resolution MSC.115(73)
** Refer to Publication IEC 60945.

2.2 The antenna design should be suitable for fitting at a position on the ship which ensures a clear view of the satellite constellations.

3 PERFORMANCE STANDARDS FOR COMBINED GPS/GLONASS RECEIVER EQUIPMENT

3.1 The combined GPS/GLONASS receiver equipment should:

.1.1 be capable of receiving and processing the Standard Positioning Service (SPS) signals of the GPS as modified by Selective Availability (SA) and range code signals in GLONASS and provide position information in latitude and longitude World Geodetic System (WGS) 84 co-ordinates in degrees, minutes and thousandths of minutes. Means may be provided to transform the computed position into data compatible with the datum of the navigational chart in use. Where this facility exists, the display and any data output should indicate that the co-ordinate conversation is being performed and should identify the co-ordinate system in which the position is expressed;

.1.2 operate on the L1 frequency signal and C/A code in GPS and L1 frequency signal and range code in GLONASS;

.1.3 be provided with at least one output from which position information can be supplied to other equipment. The output of position information should be in accordance with the relevant international standard**s**;[*]

.1.4 have static accuracy such that the position of the antenna is determined to within 35 m (95%) in non-differential mode and 10 m (95%) in differential mode with horizontal dilution of precision (HDOP) $\leq$ 4 or position dilution of precision (PDOP) $\leq$ 6;

.1.5 have dynamic accuracy such that the position of the ship is determined to within 35 m (95%) in non-differential mode and 10 m (95%) in differential mode with HDOP $\leq$ 4 or PDOP $\leq$ 6 under the conditions of sea states and ship's motion likely to be experienced in ships[**];

.1.6 be capable of selecting automatically the appropriate satellite transmitted signals for determination of the ship's position with the required accuracy and update rate;

.1.7 be capable of acquiring satellite signals with input signals having carrier levels in the range of -130 dBm to -120 dBm. Once the satellite signals have been acquired the equipment should continue to operate satisfactorily with satellite signals having carrier levels down to -133 dBm;

.1.8 be capable of acquiring position to the required accuracy, within 30 min, when there is no valid almanac data;

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[*] Publication IEC 61162.

[**] Resolution A.694(17); Publications IEC 6721-3-6, IEC 60945 and IEC 61108-3.

.1.9 be capable of acquiring position to the required accuracy, within 5 min, when there is valid almanac data;

.1.10 be capable of re-acquiring position to the required accuracy, within 5 min, when all GPS and GLONASS signals are interrupted for a period of at least 24 h, but there is no loss of power;

.1.11 be capable of re-acquiring position to the required accuracy, within 2 min, when subjected to a power interruption of 60 s;

.1.12 be capable of re-acquiring an individual satellite signal and utilizing it in the position solution within 10 s after being blocked for 30 s;

.1.13 generate and output to a display and digital interface* a new position solution at least once every 1 s;

.1.14 have a minimum resolution of position, i.e. latitude and longitude of 0.001 minutes;

.1.15 generate output to the digital interface* course over the ground (COG), speed over the ground (SOG) and universal time co-ordinated (UTC). Such outputs should have a validity mark aligned with that on the position output. The accuracy requirement for COG and SOG should not be inferior to the relevant Performance Standards for Heading** and SDME;***

.1.16 have the facilities to process DGPS and DGLONASS data fed to it, in accordance with Recommendation ITU-R M.823 and the appropriate RTCM standard; and

.1.17 be capable of operating satisfactorily in typical interference conditions.

4 PROTECTION

Precautions should be taken to ensure that no permanent damage can result from an accidental short circuit or grounding of the antenna or any of its input or output connections or any of the combined GPS/GLONASS receiver equipment inputs or outputs for a duration of 5 min.

5 FAILURE WARNINGS AND STATUS INDICATIONS

5.1 The equipment should provide an indication if the position calculated is likely to be outside of the requirements of these performance standards.

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* Conforming to Publication IEC 61162 series.

** Resolution A.424(XI).

*** Resolution A.824(19).

5.2 The combined GPS/GLONASS receiver equipment should provide as a minimum:

.1 an indication within 5 s if either:

.1.1 the specified HDOP has been exceeded; or

.1.2 a new position has not been calculated for more than 1 s.

Under such conditions the last known position and the time of the last valid fix, with explicit indication of this state, so that no ambiguity can exist, should be output until normal operation is resumed;

.2 a warning of loss of position;

.3 DGPS and DGLONASS status indication of:

.3.1 the receipt of DGPS and DGLONASS signals; and

.3.2 whether DGPS and DGLONASS corrections are being applied to the indicated ship's position;

.4 DGPS and DGLONASS integrity status and alarm; and

.5 DGPS and DGLONASS text message display.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR AUTOMATIC PILOTS*

Valid for equipment installed before 1 January 1999

Automatic pilot equipment aboard a seagoing vessel should comply with the following minimum operational requirements in addition to the general requirements contained in Assembly resolution A.281(VIII).

1 GENERAL

1.1 Within limits related to ship's manoeuvrability the automatic pilot, in conjunction with its source of heading information, should enable a vessel to keep a preset course with minimum operation of the vessel's steering gear.

1.2 The automatic pilot equipment should be capable of adapting to different steering characteristics of the vessel under various weather and loading conditions, and provide reliable operation under prevailing environmental and normal operational conditions.

2 CHANGING OVER FROM AUTOMATIC TO MANUAL STEERING AND VICE VERSA

2.1 Changing over from automatic to manual steering and vice versa should be possible at any rudder position and be effected by one, or at the most two manual controls, within a time lag of 3 s.

2.2 Changing over from automatic to manual steering should be possible under any conditions, including any failure in the automatic control system.

2.3 When changing over from manual to automatic steering, the automatic pilot should be capable of bringing the ship to the preset course.

2.4 Change-over controls should-be located close to each other in the immediate vicinity of the main steering position.

2.5 Adequate indication should be provided to show which method of steering is in operation at a particular moment.

3 ALARM SIGNALLING FACILITIES

3.1 A course monitor should be provided which actuates an adequate "off course" audible alarm signal after a course deviation of a preset amount.

3.2 The information required to actuate the course monitor should be provided from an independent source.

* Annex of Assembly Resolution A.342(IX)

3.3 Alarm signals, both audible and visual, should be provided in order to indicate failure or a reduction in the power supply to the automatic pilot or course monitor, which would affect the safe operation of the equipment.

3.4 The alarm signalling facilities should be fitted near the steering position.

4 CONTROLS

4.1 The number of operational controls should be minimized as far as possible and they should be designed to preclude inadvertent operation.

4.2 Unless features for automatic adjustments are incorporated in the installation, the automatic pilot should be provided with adequate controls for operational use to adjust effects due to weather and the ship's steering performance.

4.3 The automatic pilot should be designed in such a way as to ensure altering course to starboard by turning the course setting control clockwise. Normal alterations of course should be possible by one adjustment only of the course setting control.

4.4 Except for the course setting control, the actuation of any other control should not significantly affect the course of the ship.

4.5 Additional controls at remote positions should comply with the provisions of this Recommendation.

5 RUDDER ANGLE LIMITATION

Means should be incorporated in the equipment to enable rudder angle limitation in the automatic mode of operation. Means should also be available to indicate when the angle of limitation has been reached.

6 PERMITTED YAW

Means should be incorporated to prevent unnecessary activation of the rudder due to normal yaw motion.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR HEADING CONTROL SYSTEMS*

Valid for equipment installed on or after 1 January 1999

1 INTRODUCTION

In addition to the general requirements contained in resolution A.694(17)**, heading control systems should comply with the following minimum performance requirements.

2 OBJECTIVES

2.1 Within limits related to the ships's manoeuvrability the heading control system, in conjunction with its source of heading information, should enable a ship to keep a preset heading with minimum operation of the ship's steering gear.

2.2 A heading control system may work together with a track control system adjusting its heading for drift.

2.3 A turn rate control for performing turns may be provided.

3 FUNCTIONAL REQUIREMENTS

3.1 Adaption to steering characteristics and environmental conditions

The heading control system should be capable of adapting manually or automatically to different steering characteristics of the ship under various speed, weather and loading conditions, and provide reliable operation under prevailing environment and normal operational conditions.

3.2 Performing turns

The heading control system should be able to perform turns, within the turning capability of the ship, based either on a preset turning radius or a preset rate of turn.

3.3 Rudder angle limitation

Means should be incorporated in the equipment to enable rudder angle limitation in the automatic mode. Means should also be available to indicate when the angle of limitation has been commanded or reached. When other means of directional control are used the requirements of this section should appropriately apply.

3.4 Permitted yaw

Means should be incorporated to prevent unnecessary activation of the rudder due to normal yaw motion.

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* Annex 3 of MSC resolution MSC.64(67).
** IEC 945 Publication.

3.5 **Preset heading**

Any alteration of the preset heading should not be possible without intended action of the ship's personnel.

3.6 **Limiting of overshoot**

The heading control system should change to a preset heading without significant overshoot.

4 CHANGE-OVER FROM AUTOMATIC TO MANUAL STEERING AND VICE VERSA

4.1 Change-over from automatic to manual steering and vice-versa should be possible at any position of the rudder and should be effected by one manual control within 3 seconds.

4.2 Change-over from automatic to manual steering should be possible under any conditions including any failure in the automatic control system.

4.3 When changing over from manual to automatic steering the heading control system shall take over the actual heading as the preset heading.

4.4 There should be a single change-over control which should be located in such a position that it is easily accessible to the officer of the watch.

4.5 Adequate indication should be provided to show which method of steering is in operation.

5 CHANGE-OVER FROM TRACK CONTROL TO HEADING CONTROL

5.1 If the heading control system works as part of a track control system, then when switching from track control to heading control, the actual heading should be taken as the preset heading.

5.2 Any switching back to track control shall not be possible without intended action of the ship's personnel.

6 ALARMS AND SIGNALLING FACILITIES

6.1 **Failure or reduction in power**

An alarm both audible with mute function and visual should be provided in order to indicate failure or a reduction in the power supply to the heading control system or heading monitor, which would affect the safe operation of the equipment.

6.2 **Off-heading alarm**

An off-heading alarm, both audible with mute function and visual should be provided when the actual heading deviates from the preset heading beyond a preset limit.

6.3 **Heading monitor**

If the ship is required to carry two independent compasses, a heading monitor should be provided to monitor the actual heading information by independent heading sources. The heading monitor is not required to be an integrated part of the heading control system.

An alarm both audible with mute function and visual should be provided when the heading information in use deviates from the second heading source beyond a preset limit.

6.4 **Indication of heading source**

A clear indication of the actual heading source should be provided.

6.5 **Sensor status**

The heading control system should provide an indication when any input from external sensors used for control is absent. The heading control system should also repeat any alarm on the status messages concerning the quality of the input data from its external sensors when they are used for control.

7 CONTROLS

7.1 The number of operational controls should be such that easy and safe operation can be achieved. The controls should be designed to preclude inadvertent operation.

7.2 Unless features for automatic adjustment are incorporated in the installation, the heading control system should be provided with adequate controls to adjust to effects due to weather and the ship's steering performance.

7.3 The heading control system should be designed in such a way as to ensure altering the pre-set heading to starboard by turning the heading setting control clockwise or tilting it to the right-hand side. Normal alterations of heading should be possible by one adjustment only of the preset heading control.

7.4 Where remote control stations are provided, facilities for the delegation of control to the remote station and unconditional return of control should be incorporated in the master station.

7.5 Except for the preset heading setting control, the actuation of any other control should not significantly affect the heading of the ship.

7.6 Additional controls at remote positions should comply with the provisions of this performance standard.

8 INTERFACING

8.1 The heading control system should be connected to a suitable source of heading information.

8.2 The heading control system should be connected to a suitable source of speed information when it is used in a turning radius mode or when any control parameters are automatically adapted to speed.

8.3 If a heading control system is capable of digital serial communication with the ship's navigation system then the interface facilities should comply with the relevant international marine interface standards.*

*IEC 1162 Publication.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS)*

PART 1
Valid for equipment installed before 1 January 1999

1 INTRODUCTION

1.1 The primary function of the ECDIS is to contribute to safe navigation.

1.2 ECDIS, with adequate back-up arrangements, may be accepted as complying with the up-to-date charts required by regulation V/20 of the 1974 SOLAS Convention.

1.3 In addition to the general requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and the requirements for electronic navigational aids contained in IMO resolution A.694(17),** ECDIS should meet the requirements of this performance standard.

1.4 ECDIS should be capable of displaying all chart information necessary for safe and efficient navigation originated by, and distributed on the authority of, government-authorized hydrographic offices.

1.5 ECDIS should facilitate simple and reliable updating of the electronic navigational chart.

1.6 Use of ECDIS should reduce the navigational workload as compared to use of a paper chart. It should enable the mariner to execute in a convenient and timely manner all route planning, route monitoring and positioning currently performed on paper charts. It should be capable of continuously plotting the ship's position.

1.7 ECDIS should have at least the same reliability and availability of presentation as the paper chart published by government-authorized hydrographic offices.

1.8 ECDIS should provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment (see appendix 5).

2 DEFINITIONS

For the purpose of these performance standards:

2.1 *Electronic chart display and information system (ECDIS)* means a navigation information system which, with adequate back-up arrangements, can be accepted as complying with the up-to-date chart required by regulation V/20 of the 1974 SOLAS Convention, by displaying selected information from a system electronic navigational chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and by displaying additional navigation-related information if required.

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* Assembly Resolution A.817(19), as amended by resolutions MSC.64(67), annex 5 and MSC.86(70), annex 4, as appropriate.

** Refer to IEC Publication 945 (see appendix 1)

2.2 *Electronic navigational chart (ENC)* means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government-authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation, and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions), which may be considered necessary for safe navigation.

2.3 *System electronic navigational chart (SENC)* means a database resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means, and other data added by the mariner. It is this database that is actually accessed by ECDIS for the display generation and other navigational functions, and is the equivalent to an up-to-date paper chart. The SENC may also contain information from other sources.

2.4 *Standard display* means the SENC information that should be shown when a chart is first displayed on ECDIS. The level of the information it provides for route planning or route monitoring may be modified by the mariner according to the mariner's needs.

2.5 *Display base* means the level of SENC information which cannot be removed from the display, consisting of information which is required at all times in all geographical areas and all circumstances. It is not intended to be sufficient for safe navigation.

2.6 Further information on ECDIS definitions may be found in IHO Special Publication S-52, appendix 3 (see appendix 1).

3 DISPLAY OF SENC INFORMATION

3.1 ECDIS should be capable of displaying all SENC information.

3.2 SENC information available for display during route planning and route monitoring should be subdivided into three categories, display base, standard display, and all other information (see appendix 2).

3.3 ECDIS should present the standard display at any time by a single operator action.

3.4 When a chart is first displayed on ECDIS, it should provide the standard display at the largest scale available in the SENC for the displayed area.

3.5 It should be easy to add or remove information from the ECDIS display. It should not be possible to remove information contained in the display base.

3.6 It should be possible for the mariner to select a safety contour from the depth contours provided by the SENC. ECDIS should give the safety contour more emphasis than other contours on the display.

3.7 It should be possible for the mariner to select a safety depth. ECDIS should emphasize soundings equal to or less than the safety depth whenever spot soundings are selected for display.

3.8 The ENC and all updates to it should be displayed without any degradation of their information content.

3.9 ECDIS should provide a means of ensuring that the ENC and all updates to it have been correctly loaded into the SENC.

3.10 The ENC data and updates to it should be clearly distinguishable from other displayed information, such as, for example, that listed in appendix 3.

4 PROVISION AND UPDATING* OF CHART INFORMATION

4.1 The chart information to be used in ECDIS should be the latest edition of information originated by a government-authorized hydrographic office, and conform to IHO standards.

4.2 The contents of the SENC should be adequate and up-to-date for the intended voyage, as required by regulation V/20 of the 1974 SOLAS Convention.

4.3 It should not be possible to alter the contents of the ENC.

4.4 Updates should be stored separately from the ENC.

4.5 ECDIS should be capable of accepting official updates to the ENC data provided in conformity with IHO standards. These updates should be automatically applied to the SENC. By whatever means updates are received, the implementation procedure should not interfere with the display in use.

4.6 ECDIS should also be capable of accepting updates to the ENC data entered manually with simple means for verification prior to the final acceptance of the data. They should be distinguishable on the display from ENC information and its official updates, and not affect display legibility.

4.7 ECDIS should keep a record of updates, including time of application to the SENC.

4.8 ECDIS should allow the mariner to display updates so that the mariner may review their contents and ascertain that they have been included in the SENC.

5 SCALE

ECDIS should provide an indication of whether:

.1 the information is displayed at a larger scale than that contained in the ENC; or

.2 own ship's position is covered by an ENC at a larger scale, than that provided by the display.

* Appendix 1 to IHO Special Publication S-52 (see appendix 1).

6 DISPLAY OF OTHER NAVIGATIONAL INFORMATION

6.1 Radar information or other navigational information may be added to the ECDIS display. However, it should not degrade the SENC information, and should be clearly distinguishable from the SENC information.

6.2 ECDIS and added navigational information should use a common reference system. If this is not the case, an indication should be provided.

6.3 Radar

6.3.1 Transferred radar information may contain both the radar image and ARPA information.

6.3.2 If the radar image is added to the ECDIS display, the chart and the radar image should match in scale and in orientation.

6.3.3 The radar image and the position from the position sensor should both be adjusted automatically for antenna offset from the conning position.

6.3.4 It should be possible to adjust the displayed position of the ship manually so that the radar image matches the SENC display.

6.3.5 It should be possible to remove the radar information by single operator action.

7 DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA

7.1 It should always be possible to display the SENC in a "north-up" orientation. Other orientations are permitted.

7.2 ECDIS should provide for true motion mode. Other modes are permitted.

7.3 When true motion mode is in use, reset and generation of the neighbouring area should take place automatically at a distance from the border of the display determined by the mariner.

7.4 It should be possible manually to change the chart area and the position of own ship relative to the edge of the display.

8 COLOURS AND SYMBOLS

8.1 IHO recommended colours and symbols should be used to represent SENC information.[*]

8.2 The colours and symbols other than those mentioned in paragraph 8.1 should be those used to describe the navigational elements and parameters listed in appendix 3 and published by IEC.[**]

[*] .Appendix 2 to IHO Special Publication S-52 (see appendix 1).
[**] Refer to IEC Publication 1174.

8.3 SENC information, when displayed at the scale specified in the ENC, should use the specified size of symbols, figures and letters.[*] [**]

8.4 ECDIS should allow the mariner to select whether own ship is displayed in true scale or as a symbol.

9 DISPLAY REQUIREMENTS

9.1 ECDIS should be capable of displaying information for:

.1 route planning and supplementary navigation tasks; and

.2 route monitoring.

9.2 The effective size of the chart presentation for route monitoring should be at least 270 mm x 270 mm.

9.3 The display should be capable of complying with the colour and resolution recommendations of IHO.[*]

9.4 The method of presentation should ensure that the displayed information is clearly visible to more than one observer in the conditions of light normally experienced on the bridge of the ship by day and by night.

10 ROUTE PLANNING, MONITORING AND VOYAGE RECORDING

10.1 It should be possible to carry out route planning and route monitoring in a simple and reliable manner.

10.2 ECDIS should be designed following ergonomic principles for user-friendly operation.

10.3 The largest scale data available in the SENC for the area given should always be used by the ECDIS for all alarms or indications of crossing the ship's safety contour and of entering a prohibited area and for alarms and indications according to appendix 5.

10.4 Route planning

10.4.1 It should be possible to carry out route planning including both straight and curved segments.

10.4.2 It should be possible to adjust a planned route by, for example:

.1 adding waypoints to a route;

.2 deleting waypoints from a route;

.3 changing the position of a waypoint; and

[*] Appendix 2 to IHO Special Publication S-52 (see appendix 1).
[**] Refer to IEC Publication 1174.

.4 changing the order of the waypoints in the route.

10.4.3 It should be possible to plan an alternative route in addition to the selected route. The selected route should be clearly distinguishable from the other routes.

10.4.4 An indication is required if the mariner plans a route across an own ship's safety contour.

10.4.5 An indication is required if the mariner plans a route across the boundary of a prohibited area or of a geographical area for which special conditions exist (see appendix 4).

10.4.6 It should be possible for the mariner to specify a limit of deviation from the planned route at which activation of an automatic off-track alarm should occur.

10.5 Route monitoring

10.5.1 For route monitoring the selected route and own ship's position should appear whenever the display covers that area.

10.5.2 It should be possible to display a sea area that does not have the ship on the display (e.g. for look ahead, route planning), while route monitoring. If this is done on the display used for route monitoring, the automatic route monitoring functions (e.g. updating ship's position, and providing alarms and indications) should be continuous. It should be possible to return to the route monitoring display covering own ship's position immediately by single operator action.

10.5.3 ECDIS should give an alarm if the ship, within a specified time set by the mariner, is going to cross the safety contour.

10.5.4 ECDIS should give an alarm or indication, as selected by the mariner, if the ship, within a specified time set by the mariner, is going to cross the boundary of a prohibited area or of a geographical area for which special conditions exist (see appendix 4).

10.5.5 An alarm should be given when the specified limit for deviation from the planned route is exceeded.

10.5.6 The ship's position should be derived from a continuous positioning system of an accuracy consistent with the requirements of safe navigation. Whenever possible, a second independent positioning method of a different type should be provided; ECDIS should be capable of identifying discrepancies between the two systems.

10.5.7 ECDIS should provide an indication when the input from the position-fixing system is lost. ECDIS should also repeat, but only as an indication, any alarm or indication passed to it from a position-fixing system.

10.5.8 An alarm should be given by ECDIS if the ship, within a specified time or distance set by the mariner, is going to reach a critical point on the planned route.

10.5.9 The positioning system and the SENC should be on the same geodetic datum. ECDIS should give an alarm if this is not the case.

10.5.10 It should be possible to display an alternative route in addition to the selected route. The selected route should be clearly distinguishable from the other routes. During the voyage. it should be possible for the mariner to modify the selected sailing route or change to an alternative route.

10.5.11 It should be possible to display:

.1 time-labels along ship's track, manually on demand and automatically at intervals selected between 1 and 120 m; and

.2 an adequate number of: points, free movable electronic bearing lines, variable and fixed-range markers and other symbols required for navigation purposes and specified in appendix 3.

10.5.12 It should be possible to enter the geographical co-ordinates of any position and then display that position on demand. It should also be possible to select any point (features, symbol or position) on the display and to read its geographical co-ordinates on demand.

10.5.13 It should be possible to adjust the ship's geographical position manually. This manual adjustment should be noted alphanumerically on the screen, maintained until altered by the mariner, and automatically recorded.

10.6 Voyage recording

10.6.1 ECDIS should store and be able to reproduce certain minimum elements required to reconstruct the navigation and verify the official database used during the previous 12 h. The following data should be recorded at one-minute intervals:

.1 to ensure a record of own ship's past track: time, position, heading, and speed; and

.2 to ensure a record of official data used: ENC source, edition, date, cell and update history.

10.6.2 In addition, ECDIS should record the complete track for the entire voyage, with time marks at intervals not exceeding 4 h.

10.6.3 It should not be possible to manipulate or change the recorded information.

10.6.4 ECDIS should have the capability to preserve the record of the previous 12 h and of the voyage track.

11 ACCURACY

11.1 The accuracy of all calculations performed by ECDIS should be independent of the characteristics of the output device and should be consistent with the SENC accuracy.

11.2 Bearings and distances drawn on the display, or those measured between features already drawn on the display, should have an accuracy no less than that afforded by the resolution of the display.

12 CONNECTIONS WITH OTHER EQUIPMENT*

12.1 ECDIS should not degrade the performance of any equipment providing sensor inputs. Nor should the connection of optional equipment degrade the performance of ECDIS below this standard.

12.2 ECDIS should be connected to systems providing continuous position fixing, heading and speed information.

13 PERFORMANCE TESTS, MALFUNCTION ALARMS AND INDICATIONS

13.1 ECDIS should be provided with means for carrying out on-board tests of major functions either automatically or manually. In case of a failure, the test should display information to indicate which module is at fault.

13.2 ECDIS should provide a suitable alarm or indication of system malfunction.

14 BACK-UP ARRANGEMENTS

Adequate back-up arrangements should be provided to ensure safe navigation in case of an ECDIS failure.

.1 Facilities enabling a safe take-over of the ECDIS functions should be provided in order to ensure that an ECDIS failure does not result in a critical situation.

.2 A back-up arrangement should be provided facilitating means for safe navigation of the remaining part of the voyage in case of an ECDIS failure.

15 POWER SUPPLY

15.1 It should be possible to operate ECDIS and all equipment necessary for its normal functioning when supplied by an emergency source of electrical power in accordance with the appropriate requirements of chapter II-1 of the 1974 SOLAS Convention.

15.2 Changing from one source of power supply to another, or any interruption of the supply for a period of up to 45 s, should not require the equipment to be reinitialised manually.

* Refer to IEC Publication 1162

Appendix 1
REFERENCE DOCUMENTS

The following international organizations have developed technical standards and specifications, as listed below, for use in conjunction with this standard. The latest edition of these documents should be obtained from the organization concerned.

INTERNATIONAL HYDROGRAPHIC ORGANIZATION (IHO)

Address: Directing Committee
International Hydrographic Bureau
BP 445
98011 Monaco CEDEX
Principality of Monaco

Phone: + 37793 5065 87
Fax: + 377 93 25 2003

Publications

Special Publication No.S-52, *Provisional Specifications for Chart Content and Display of ECDIS,* 2nd Edition, September 1992.
S-52 appendix 1, "Report of the IHO (COE) Working Group on Updating the Electronic Chart", 1st Edition. June 1990.
S-52 appendix 2 "Provisional Colour and Symbol Specifications for ECDIS", 1st Edition, February 1991.
S-52 appendix 3, "Glossary of ECDlS-Related Terms" 1st Edition July 1991.
Special Publication No.S-57, *IHO Transfer Standard for Digital Hydrographic Data.*

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

Address: IEC Central Office
3 rue de Varembé
PO Box 131
1211 Geneva 20
Switzerland

Phone: + 41 22 734 01 50
Fax: + 41 22 733 38 43

Publications

IEC Publication 1174, *Electronic Chart Display and Information System (ECDIS).*

IEC Publication 945, *General Requirements for Shipborne Radio Equipment Forming Part of the Global Maritime Distress and Safety System and Marine Navigational Equipment.*

IEC Publication 1162, *Digital Interfaces - Navigation and Radiocommunication Equipment On Board Ship.*

Appendix 2

SENC INFORMATION AVAILABLE FOR DISPLAY DURING ROUTE PLANNING AND ROUTE MONITORING

1 Display base, permanently retained on the ECDIS display, consisting of:

.1 coastline (high water);

.2 own ship's safety contour, to be selected by the mariner;

.3 indication of isolated underwater dangers at depths of less than the safety contour which lie within the safe waters defined by the safety contour;

.4 indication of isolated dangers which lie within the safe water defined by the safety contour such as bridges, overhead wires, etc., including buoys and beacons, whether or not these are being used as aids to navigation;

.5 traffic routeing systems;

.6 scale, range, orientation and display mode; and

.7 units of depth and height.

2 Standard display, to be displayed when the chart is first displayed by ECDIS, consisting of:

.1 display base

.2 drying line

.3 indication of fixed and floating aids to navigation

.4 boundaries of fairways, channels, etc.

.5 visual and radar conspicuous features

.6 prohibited and restricted areas

.7 chart scale boundaries

.8 indication of cautionary notes

3 All other information, displayed individually on demand, for example:

.1 spot soundings

.2 submarine cables and pipelines

.3 ferry routes

.4 details of all isolated dangers

.5 details of aids to navigation

.6 contents of cautionary notes

.7 ENC edition date

.8 geodetic datum

.9 magnetic variation

.10 graticule

.11 place names.

Appendix 3
NAVIGATIONAL ELEMENTS AND PARAMETERS*

1 Own ship

.1 Past track with time marks for primary track

.2 Past track with time marks for secondary track

2 Vector for course and speed made good

3 Variable range marker and/or electronic bearing line

4 Cursor

5 Event

.1 Dead reckoning position and time (DR)

.2 Estimated position and time (EP)

6 Fix and time

7 Position line and time

8 Transferred position line and time

.1 Predicted tidal stream or current vector with effective time and strength (in box)

.2 Actual tidal stream or current vector with effective time and strength (in box)

9 Danger highlight

10 Clearing line

11 Planned course and speed to make good. Speed is shown in box

12 Waypoint

13 Distance to run

14 Planned position with date and time

15 Visual limits of lights arc to show rising/dipping range

16 Position and time of "wheelover"

* Refer to IEC Publication 1174.

Appendix 4
AREAS FOR WHICH SPECIAL CONDITIONS EXIST

The following are the areas, which ECDIS should detect and for which it should provide an alarm or indication under paragraphs 10.4.5 and 10.5.4:

Traffic separation zone
Traffic routeing scheme crossing or roundabout
Traffic routeing scheme precautionary area
Two-way traffic route
Deep-water route
Recommended traffic lane
Inshore traffic zone
Fairway
Restricted area
Caution area
Offshore production area
Areas to be avoided
Military practice area
Seaplane landing area
Submarine transit lane
Ice area
Channel
Fishing ground
Fishing prohibited
Pipeline area
Cable area
Anchorage area
Anchorage prohibited
Dumping ground
Spoil ground
Dredged area
Cargo transhipment area
Incineration area
Specially protected areas

Appendix 5
ALARMS AND INDICATORS

Section	**Requirements**	**Information**
10.3	Alarm or Indication	Largest scale for alarm
10.4.6	Alarm	Exceeding off-track limits
10.5.3	Alarm	Crossing safety contour
10.5.4	Alarm or Indication	Area with special conditions
10.5.5	Alarm	Deviation from route
10.5.8	Alarm	Approach to critical point
10.5.9	Alarm	Different geodetic datum
13.2	Alarm or Indication	Malfunction of ECDIS
5.1	Indication	Information overscale
5.2	Indication	Larger scale ENC available
6.2	Indication	Different reference system
10.4.4	Indication	Route planning across safety contour
10.4.5	Indication	Route planning across specified area
10.5.7	Indication	Positioning system failure
13.1	Indication	System test failure

In this Performance Standard the definitions of indicators and alarms provided in the IMO publication *Code on Alarms and Indicators* (IMO-867E) apply.

Alarm: An alarm or alarm system which announces by audible means, or audible and visual means, a condition requiring attention.

Indicator: Visual indication giving information about the condition of a system or equipment.

PART 2*
Amendments to Part 1, valid for equipment installed on or after 1 January 1999

Add a new Appendix 6 to the Annex to the resolution:

Appendix 6
BACK-UP REQUIREMENTS

1 INTRODUCTION

As prescribed in section 14 of this Performance Standard, adequate independent back-up arrangements should be provided to ensure safe navigation in case of ECDIS failure. Such arrangements include:

.1 facilities enabling a safe take-over of the ECDIS functions in order to ensure that an ECDIS failure does not result in a critical situation; and

.2 a means to provide for safe navigation for the remaining part of the voyage in case of ECDIS failure.

2 PURPOSE

The purpose of an ECDIS back-up system is to ensure that safe navigation is not compromised in the event of ECDIS failure. This should include a timely transfer to the back-up system during critical navigation situations. The back-up system shall allow the vessel to be navigated safely until the termination of the voyage.

3 FUNCTIONAL REQUIREMENTS

3.1 Required functions and their availability

3.1.1 *Presentation* of *chart information*

The back-up system should display in graphical (chart) form the relevant information of the hydrographic and geographic environment which is necessary for safe navigation.

3.1.2 *Route planning*

The back-up system should be capable of performing the route planning functions, including:

.1 taking over of the route plan originally performed on the ECDIS; and

.2 adjusting a planned route manually or by transfer from a route planning device.

* Annex 5 of MSC Resolution MSC.64(67)

3.1.3 *Route monitoring*

The back-up system should enable a take-over of the route monitoring originally performed by the ECDIS, and provide at least the following functions:

.1 plotting own ship's position automatically, or manually on a chart;

.2 taking courses, distances and bearings from the chart;

.3 displaying the planned route;

.4 displaying time labels along ship's track; and

.5 plotting an adequate number of points, bearing lines, range markers, etc., on the chart.

3.1.4 *Display information*

If the back-up is an electronic device, it should be capable of displaying at least the information equivalent to the standard display as defined in this performance standard.

3.1.5 *Provision of chart information*

.1 The chart information to be used should be the latest editions of that originated by a government hydrographic office, and based on IHO standards.

.2 It should not be possible to alter the contents of the electronic chart information.

.3 The chart or chart data edition and issuing date should be indicated.

3.1.6 *Updating*

The information displayed by the ECDIS back-up arrangements should be up-to-date for the entire voyage.

3.1.7 *Scale*

If an electronic device is used, it should provide an indication:

.1 if the information is displayed at a larger scale than that contained in the database; and

.2 if own ship's position is covered by a chart at a larger scale than that provided by the system.

3.1.8 If radar and other navigational information are added to an electronic back-up display, all the corresponding requirements of this performance standard should be met.

3.1.9 If an electronic device is used, the display mode and generation of the neighbouring area should be in accordance with section 7 of this performance standard.

3.1.10 *Voyage recording*

The back-up arrangements should be able to keep a record of the ship's actual track, including positions and corresponding times.

3.2 Reliability and accuracy

3.2.1 *Reliability*

The back-up arrangements should provide reliable operation under prevailing environmental and normal operating conditions.

3.2.2 *Accuracy*

Accuracy shall be in accordance with section 11 of this performance standard.

3.3 Malfunctions, warnings, alarms and indications

If an electronic device is used, it should provide a suitable indication of system malfunction.

4 OPERATIONAL REQUIREMENTS

4.1 Ergonomics

If an electronic device is used, it should be designed in accordance with the ergonomic principles of ECDIS.

4.2 Presentation of information

4.2.1 Colours and symbols used in the back-up arrangements should be based on IHO recommendations.

4.2.2 If an electronic device is used, the effective size of the chart presentation shall be in accordance with section 9.2 of this performance standard.

5 POWER SUPPLY

If an electronic device is used:

.1 the back-up power supply should be separate from the ECDIS; and

.2 conform to the requirements in this ECDIS performance standard.

6 CONNECTIONS WITH OTHER EQUIPMENT

6.1 If an electronic device is used, it should:

.1 be connected to systems providing continuous position-fixing capability; and

.2 not degrade the performance of any equipment providing sensor input.

6.2 If radar with selected parts of the ENC chart information overlay is used as an element of the back-up, the radar should comply with resolution A.477(XII), as amended.

PART 3*

Amendments to Part 1, valid for equipment installed on or after 1 January 2000

Add a new paragraph 1.9

1.9 When the relevant chart information is not available in the appropriate form (see section 4), some ECDIS equipment may operate in the Raster Chart Display System (RCDS) mode as defined in Appendix 7. Unless otherwise specified in Appendix 7, the RCDS mode of operation should conform to performance standards not inferior to those set out in this Annex.

Modify paragraph 10.5.7 as follows:

10.5.7 ECDIS should provide an alarm when the input from the position-fixing system is lost. ECDIS should also repeat, but only as an indication, any alarm or indication passed to it from a position-fixing system.

In Appendix 5, paragraph 10.5.7 change the word "indication" to "alarm".

Add a new Appendix 7 to the Annex to the resolution:

APPENDIX 7

RCDS MODE OF OPERATION

Whenever in this appendix a reference is made to provisions of the Annex related to ECDIS, ECDIS should be substituted by RCDS, SENC by SRNC and ENC by RNC, as appropriate.

All paragraphs of the Annex related to ECDIS are indicated as to whether they apply to RCDS, do not apply to RCDS, or are modified in order to apply to RCDS. These paragraphs are followed by additional requirements for ECDIS equipment in the RCDS mode.

1 INTRODUCTION

1.1 Paragraph applies to RCDS.

1.2 When operating in the RCDS mode, ECDIS equipment should be used together with an appropriate portfolio of up-to-date paper charts.

1.3-1.7 Paragraphs apply to RCDS.

1.8 RCDS should provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment (see Table 1 of this Appendix).

* Annex 4 of MSC resolution MSC.86(70)

2 DEFINITIONS

2.1 Raster Chart Display System (RCDS) means a navigation information system displaying RNCs with positional information from navigation sensors to assist the mariner in route planning and route monitoring and, if required, display additional navigation-related information.

2.2 Raster Navigational Chart (RNC) means a facsimile of a paper chart originated by, or distributed on the authority of, a government-authorized hydrographic office. RNC is used in these standards to mean either a single chart or a collection of charts.

2.3 System Raster Navigational Chart Database (SRNC) means a database resulting from the transformation of the RNC by the RCDS to include updates to the RNC by appropriate means.

2.4-2.5 Paragraphs do not apply to RCDS.

2.6 Paragraph applies to RCDS.

3 DISPLAY OF SRNC INFORMATION

3.1 Paragraph applies to RCDS.

3.2 SRNC information available for display during route planning and route monitoring should be subdivided into two categories:

.1 the RCDS standard display consisting of RNC and its updates, including its scale, the scale at which it is displayed, its horizontal datum, and its units of depths and heights; and

.2 any other information such as mariner's notes.

3.3 Paragraph applies to RCDS.

3.4 When a RNC is displayed on the RCDS, it should provide an indication advising the mariner if a more detailed (larger scale) RNC is available for the displayed area.

3.5 It should be easy to add to, or remove from, the RCDS display any information additional to the RNC data, such as mariner's notes. It should not be possible to remove any information from the RNC.

3.6-3.7 Paragraphs do not apply to RCDS.

3.8-3.10 Paragraphs apply to RCDS.

3.11 There should always be an indication if the ECDIS equipment is operating in the RCDS mode.

4 PROVISION AND UPDATING OF CHART INFORMATION

4.1 The RNC used in RCDS should be the latest edition of that originated by, or distributed on the authority of, a government authorized hydrographic office and conform to IHO standards. RNCs not on WGS-84 or PE-90 should carry meta-data (i.e., additional data) to allow geo-referenced positional data to be displayed in the correct relationship to SRNC data.

4.2 The contents of the SRNC should be adequate and up-to-date for that part of the intended voyage not covered by ENC.

4.3-4.8 All paragraphs apply to RCDS.

5 SCALE

This section applies to RCDS.

6 DISPLAY OF OTHER NAVIGATIONAL INFORMATION

6.1-6.3 All paragraphs apply to RCDS.

7 DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA

7.1 It should always be possible to display the RNC in "chart-up" orientation. Other orientations are permitted.

7.2-7.4 All paragraphs apply to RCDS.

8 COLOURS AND SYMBOLS

8.1 IHO recommended colours and symbols should be used to represent SRNC information.

8.2 Paragraph applies to RCDS.

8.3 Paragraph does not apply to RCDS.

8.4 Paragraph applies to RCDS.

9 DISPLAY REQUIREMENTS

9.1-9.2 Paragraphs apply to RCDS.

9.3 Paragraph does not apply to RCDS.

9.4 Paragraph applies to RCDS.

9.5 RCDS should be capable of displaying, simply and quickly, chart notes which are not located on the portion of the chart currently being displayed.

10 ROUTE PLANNING, MONITORING AND VOYAGE RECORDING

10.1-10.2 Paragraphs apply to RCDS.

10.3 Paragraph does not apply to RCDS.

10.4 Route Planning

10.4.1-10.4.3 Paragraphs apply to RCDS.

10.4.4-10.4.5 Paragraphs do not apply to RCDS.

10.4.6 Paragraph applies to RCDS.

10.4.7 It should be possible for the mariner to enter points, lines and areas which activate an automatic alarm. The display of these features should not degrade the SRNC information and it should be clearly distinguishable from the SRNC information.

10.5 Route monitoring

10.5.1 Paragraph applies to RCDS.

10.5.2 It should be possible to display a sea area that does not have the ship on the display (e.g. for look ahead, route planning), while route monitoring. If this is done on the display used for route monitoring, the automatic route monitoring functions in 10.4.6 and 10.4.7 should be continuous. It should be possible to return to the route monitoring display covering own ship's position immediately by single operator action.

10.5.3-10.5.4 Paragraphs do not apply to RCDS.

10.5.5-10.5.8 Paragraphs apply to RCDS.

10.5.9 The RCDS should only accept data referenced to the WGS-84 or PE-90 geodetic datums. RCDS should give an alarm if the positional data is not referenced to one of these datums.

10.5.10-10.5.13 Paragraphs apply to RCDS.

10.5.14 RCDS should allow the user to manually align the SRNC with positional data. This can be necessary, for example, to compensate for local charting errors.

10.5.15 It should be possible to activate an automatic alarm when the ship crosses a point, line, or is within the boundary of a mariner-entered feature within a specified time or distance.

10.6 Voyage recording

10.6.1-10.6.4 All paragraphs apply to RCDS.

11 ACCURACY

11.1-11.2 All paragraphs apply to RCDS.

12 CONNECTIONS WITH OTHER EQUIPMENT

12.1-12.2 All paragraphs apply to RCDS.

13 PERFORMANCE TESTS, MALFUNCTION ALARMS AND INDICATIONS

13.1-13.2 All paragraphs apply to RCDS.

14 BACK-UP ARRANGEMENTS

All paragraphs apply to RCDS.

15 POWER SUPPLY

15.1-15.2 All paragraphs apply to RCDS.

Table 1

ALARMS AND INDICATORS IN THE RCDS MODE OF OPERATION

Paragraph	Requirement	Information
10.4.6, 10.5.5	Alarm	Deviation from route
10.4.7, 10.5.15	Alarm	Approach to critical point, line, area or mariner-entered feature
10.5.7	Alarm	Positioning system failure
10.5.8	Alarm	Approach to critical point
10.5.9	Alarm	Different geodetic datum
13.2	Alarm	Malfunction of RCDS mode
3.11	Indication	ECDIS operating in the raster mode
3.4, 5.1	Indication	Information under-scale or overscale
5.2	Indication	Larger scale RNC available for the area of the vessel

The definitions of alarms and indicators are given in Appendix 5.

RECOMMENDATION ON PERFORMANCE STANDARDS FOR DAYLIGHT SIGNALLING LAMPS*

Valid for equipment fitted on or after 1 July 2002

1 OBJECTIVES OF DAYLIGHT SIGNALLING LAMPS FOR CRAFTS

Daylight signalling lamps should be suitable for conveying information between ships, or between ship and shore, by means of light signals, both by day and by night.

2 APPLICATION

These performance standards should be applied to daylight signalling lamps, which are required for certain ships pursuant to chapter V of the International Convention for the Safety of Life at Sea, 1974, as amended, and chapter 8 of the International Code of Safety for High-Speed Craft, in force.

3 RELATED REQUIREMENTS INVOLVED

The following standards should be additionally applied, as far as applicable:

- Resolution A.694(17) on General Requirements for Shipborne Radio Equipment forming Part of the Global Maritime Distress and Safety System (GMDSS) and for Electronic Navigational Aids;

- Resolution A.813(19) on General Requirements for Electromagnetic Compatibility (EMC) for all Electrical and Electronic Ship's Equipment;

- IEC Publication 60945 "Maritime Navigation and Radiocommunication Equipment and Systems-General Requirements, Methods of Testing and Required Test Results"; and

- CIE Publication No. 2.2 "Colors of Light Signals".

4 DEFINITIONS

"Daylight signalling lamps" means lamps suitable for transmitting white light signals to an observer by focused light beams which may be fixed or portable.

"Switch-on time" means the period of time required for reaching 95% of the required luminous intensity after the daylight signalling lamp has been switched on.

"Switch-off time" means the period of time required for luminous intensity to decrease to 5% of the required luminous intensity after the daylight signalling lamp has been switched off.

* Annex of MSC resolution MSC.95(72)

5 FUNCTIONAL REQUIREMENTS

5.1 Required functions and their availability

Daylight signalling lamps should be suitable for giving light signals, which can be clearly distinguished visually as separate signals by an observer.

5.2 Reliability, accuracy and discrimination

5.2.1 By day and with an atmospheric transmission of 0.8, the visibility of light signals emitted by daylight signalling lamps should be at least 2 nautical miles, equalling a required luminous intensity of 60,000 cd.

5.2.2 The axial luminous intensity of daylight signalling lamps should reach at least 90% of the maximum luminous intensity.

5.2.3 The luminous intensity of daylight signalling lamps should have its maximum in the centre of the luminous intensity distribution. It should decrease evenly from the centre of luminous intensity distribution.

5.2.4 The half angle of divergence α_h should not exceed 9□, the tenth angle of divergence α_z should not exceed 14□.

5.2.5 The chromaticity of the white signal light should lie within the following corner co-ordinates of the diagram specified by the International Commission on Illumination (CIE) in CIE Publication No. 2.2:

x	0.525	0.525	0.452	0.310	0.310	0.443
y	0.382	0.440	0.440	0.348	0.283	0.382

5.2.6 The effective light emission sectors of daylight signalling lamps should be circular. The sum of switch-on and switch-off times should not exceed 500 ms.

5.3 Malfunctions, warnings, alarms and indications

Daylight signalling lamps should be provided with an indication of their operational status.

6 OPERATIONAL REQUIREMENTS

6.1 Ergonomy

Daylight signalling lamps and any battery required for operation should be designed in such a way that safe handling in the intended application is ensured. The daylight signalling lamp should be capable of being operated by personnel wearing gloves.

6.2 Operational controls

The operational controls of daylight signalling lamps should meet the requirements of resolution A.694(17) and the applicable international standards.*

7 DESIGN AND INSTALLATION

7.1 Durability and resistance to environmental conditions

7.1.1 The illuminant should be safely fitted in the daylight signalling lamp; use of screwed sockets should be avoided.

7.1.2 Daylight signalling lamps should be designed in such a way that the illuminant can be easily replaced also in the dark.

7.1.3 The sighting mechanism should be mounted in a fixed attitude, parallel to the optical axis.

7.1.4 All parts of daylight signalling lamps should be made of anti-magnetic material.

7.1.5 Daylight signalling lamps should be so constructed that the accumulation of condensed water is avoided.

7.1.6 The materials used should withstand heat generation during operation.

7.1.7 With respect to durability and resistance to environmental conditions, daylight signalling lamps should meet the requirements specified in resolution A.694(17) and in the applicable international standards.*

7.2 Interference

With respect to electrical and electromagnetic interference daylight signalling lamps should meet the requirements of resolutions A.694(17) and A.813(19) and the applicable international standards.*

7.3 Power supply

7.3.1 Daylight signalling lamps should not be solely dependent upon the ship's main or emergency sources of electrical energy.

7.3.2 Daylight signalling lamps should be provided with a portable battery with a complete weight of not more than 7.5 kg.

7.3.3 The portable battery should have sufficient capacity to operate the daylight signalling lamp for a period of not less than 2 h.

7.3.4 The power supply of daylight signalling lamps should meet the requirements of resolution A.694(17) and the applicable international standards.*

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* Refer to IEC Publication 60945

7.4 Maintenance

With respect to maintenance, daylight signalling lamps should meet the requirements of resolution A.694(17) and the applicable international standards.*

8 BACK-UP AND FALL-BACK ARRANGEMENTS

Each daylight signalling lamp should be provided with at least three spare illuminants complying with the type-tested illuminant.

9 SAFETY PRECAUTIONS

The outer parts of daylight signalling lamps should not reach temperatures during operation which restrict their manual use. Additionally, daylight signalling lamps should meet the safety requirements of resolution A.694(17) and the applicable international standards.*

10 MARKING AND IDENTIFICATION

10.1 Daylight signalling lamps should be marked clearly and durably with the following data:

.1 identification of the manufacturer;
.2 equipment type number or model identification under which it was type tested; and
.3 serial number of the unit.

10.2 On the illuminant, the manufacturer's label and the voltage and power consumption should be marked clearly and durably.

10.3 Daylight signalling lamps should further be marked to meet the requirements of resolution A.694(17) and the applicable international standards.*

11 DOCUMENTATION

Daylight signalling lamps should be delivered complete with their technical documentation. Such documentation should include the following information, if applicable:

General information:

- manufacturer;
- type designation;
- general description of the equipment; and
- ancillary equipment and description.

Instructions for operation of equipment:

- general information on mains connection;
- power supply data (voltage, power consumption);
- description of start-up procedures; and
- description of ways of checking the parallel adjustment of sighting mechanism and luminous intensity axis.

* Refer to IEC Publication 60945

Troubleshooting; maintenance and service :

- description of illuminant replacement;
- description of adjustment of sighting mechanism;
- special tools required, maintenance material and spare parts (e.g. spare illuminants, fuses, mirrors and covers);
- equipment care and maintenance on board; and
- available services.

Documentation for daylight signalling lamps should meet the requirements of resolution A.694(17) and the applicable international standards.*

* Refer to IEC Publication 60945

ANNEX IX

RECOMMENDED STANDARDS FOR PILOT LADDERS*

2 PILOT LADDERS

2.1 Position and construction

2.1.1 The securing strongpoints, shackles and securing ropes should be at least as strong as the side ropes specified in 2.2 below.

2.1.2 The steps of the pilot ladders should comply with the following requirements:

.**1** if made of hardwood, they should be made in one piece, free of knots;

.**2** if made of material other than hardwood, they should be of equivalent strength, stiffness and durability to the satisfaction of the Administration;

.**3** the four lowest steps may be of rubber of sufficient strength and stiffness or other material to the satisfaction of the Administration;

.**4** they should have an efficient non-slip surface;

.**5** they should be not less than 400 mm between the side ropes, 115 mm wide and 25 mm in depth, excluding any non-slip device or grooving;

.**6** they should be equally spaced not less than 300 mm or more than 380 mm apart; and

.**7** they should be secured in such a manner that each will remain horizontal.

2.1.3 No pilot ladder should have more than two replacement steps which are secured in position by a method different from that used in the original construction of the ladder, and any steps so secured should be replaced as soon as reasonably practicable by steps secured in position by the method used in the original construction of the pilot ladder. When any replacement step is secured to the side ropes of the pilot ladder by means of grooves in the sides of the step, such grooves should be in the longer sides of the step.

2.1.4 Pilot ladders with more than five steps should have spreader steps not less than 1.8 m long provided at such intervals as will prevent the pilot ladder from twisting. The lowest spreader step should be the fifth step from the bottom of the ladder and the interval between any spreader step and the next should not exceed nine steps.

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* Extracts from annex of Resolution A.889(21)~~Regulation 17 of Chapter V of the 1960 Convention, application of which to fishing vessels and vessels of less than 500 tons gross when engaged on voyages, in the course of which pilots are likely to be employed, was recommended by IMCO in Resolution A.130(V).~~

2.2 Ropes

2.2.1 The side ropes of the pilot ladder should consist of two uncovered ropes not less than 18 mm in diameter on each side and should be continuous, with no joins below the top step.

2.2.2 Side ropes should be made of manila or other material of equivalent strength, durability and grip which has been protected against actinic degradation and is satisfactory to the Administration.

~~Whenever the distance from sea level to the point of access to the vessel is more than 9 m, access from the pilot ladder to the vessel should be by means of an accommodation ladder or other equally safe and convenient means.~~

~~Treads of pilot ladders should be not less than 48 cm long, 11.4 cm wide and 2.5 cm in depth. Steps should be joined in such a manner as will provide a ladder of adequate strength whose treads are maintained in a horizontal position and not less than 30.5 cm or more than 38 cm apart.~~

~~A man-rope and a safety line should be provided for ready use if required.~~

~~Handholds should be provided to assist pilots to pass safely and conveniently from the head of the ladder into the vessel or on to the vessel's deck.~~

~~If necessary spreaders should be provided at such intervals as will prevent the ladder from twisting.~~

~~A vessel with rubbing bands or whose construction makes it impossible to comply fully with the provision that the ladder should be secured at a place where each step will rest firmly against the vessel's side should comply with this provision as closely as possible.~~